THE AMERICAN GAS LIGHT JOURNAL

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, HEATING, MECHANICAL, CHEMICAL AND GENERAL SCIENCE.

VOLUME LXXIII.—No. 24. Whole No. 1,331. | NEW YORK, MONDAY, DECEMBER 10, 1900. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager. THOMAS J. CUNNINGHAM and ELBERT P. CALLENDER, Editors.

Published on each Monday of the year, at No. 32 Pine Street, New York.

Collections are invariably made directly from this office for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $5 (£1—25 francs). All payments to be made in advance. Single copies, 10 cents.

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ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

BRIEFLY TOLD.

THE SORE STRAITS OF THE KENTUCKY HEATING COMPANY.—Kentucky is a queer sort of a State, and its queerness largely rests on the basis that one may not always count on what is to come out of it next. But, as years go on, despite the unfortunate fact that personal and political differences there often lead to tragedies of the blackest sort, it is beyond question that real rights of ownership in property are as well taken care of under the laws of Kentucky as such rights are preserved in any other State of the Union. Political or personal prejudices may dictate the challenge or precipitate the fight, but in the end a fair and square interpretation of the law in the State of Kentucky is at least as easily and safely obtained as it is in the State of New York. In fact, when it comes to a question of franchise rights and their just interpretation, writing candidly from our knowledge of the subject, we would prefer our chances for holding what we were told we were going to get in Kentucky, rather than in New York, either from the lawmaking or law construing standpoint. These introductory, dispassionate sentences are put out in a bit of a humoristic way, and to no one else will they appeal more forcibly than to Mr. Donald McDonald, President of the Kentucky Heating Company, of Louisville, whose management of the supply of natural gas to the residents of Kentucky's largest city seems to have been largely of the hypothetical order. Mr. McDonald's Company was granted originally the privilege of supplying natural gas in Louisville, for heating purposes only, but there came a time when (in fact the time comes each winter) the supply of natural gas there was inadequate to the people's needs on heating account, to say nothing of lighting use. To relieve themselves of all doubt of fealty to the public, either on heating or lighting account, through a failure of the natural gas supply, Mr. McDonald and his associates eked out nature, through the construction of an apparatus that could be depended on to be busy while nature was resting. In fact to make an old story new, the Kentucky Heating Company, chartered and provisioned especially for the distributing of natural gas for heating use only, engaged in the making of gas, and went to the further length of asserting that, the consumers having gotten the gas beyond the outlet of their meters, it was no part of the Company's business in what line the gas was used. The Louisville Gas Company, however, was also in the business of selling manufactured gas for any use in the city, and its proprietors considered that their charter rights were worth preserving. Accordingly suit was brought to restrain the Kentucky Heating Company from exceeding the prescribed limits of its commission. The first and second steps in the litigation were decided in favor of the contention of the Louisville Gas Company, and the Court of Appeals, in the ending week of last November, declared in no uncertain terms sustaining the lower verdicts. Simply stated, the burden of the decision is that the Kentucky Heating Company may supply fuel gas for heating purposes only, and that it is responsible for any use of gas by its consumers on illuminating account, no matter the nature of the device employed by the consumer to convert heating effect into lighting effect. In other words, the court of last resort in Kentucky has the courage to affirm that the fair and reasonable provisions of a contract between the State

and one or more of its corporation creatures must be carried out. President Snead and Engineer Barret are to be congratulated on the singleness of purpose and their grit shown in carrying on this contest, and the result of it all will be rather discomforting to Mr. McDonald and his associates, when the time comes for them to ask from capitalists for further favors.

NOTES.—We are in receipt of a handsome photographic reproduction of the exhibit made by the Nashville (Tenn.) Gas Company during the occasion of the Nashville Street Fair last fall. The Company put up an excellent display of gas apparatus and appliances, prominent among which, of course, were types of the improved Welsbach and Kern burners. Quite a feature of the exhibit was a working example of two or more types of instantaneous water heaters, and another attractive display was a gas log doing its best work. Hot cake, cooked while you looked, was in evidence day and night. The show attracted more attention than any other separate one during the Fair; and Mr. J. Frank Stacey, the Company's wide-awake Superintendent, is to be given the greatest part of the credit for arranging the exhibit and for keeping it up.——The successor to the Peekskill (N. Y.) Gas Light Company is the Peekskill Lighting and Railroad Company.——Mr. Andrew W. De Forest, President of the New Haven (Conn.) Gas Light Company, died at his home in that city the evening of November 29th. Deceased was in his 84th year, having been born in Humphreysville (now known as Seymour), Conn., in 1806. He amassed a fortune, the greater part of which resulted from safe investments of moneys made in lumber trading. He never was in any sense a practical gas man. He was much respected in the mercantile life of New Haven.——Mr. Granville O. Holmes, at one time prominent in the management of the electric lighting interests of Danbury, Conn., is dead.

Natural Gas May be Legally Exported from Indiana.

Press advices, dated November 27th, from Indianapolis, Ind., are to the effect that, under a decision of the Indiana Supreme Court, rendered the day named, the city of Chicago cannot be denied its supply of natural gas from the Indiana fields, for the law which was invoked to confine the product to Indiana was declared unconstitutional and void.

This means that the Indiana Natural Gas and Oil Company, which is supplying Chicago, may continue to pipe gas to that city, as long as it conforms to the law governing the transportation of natural gas, and a company supplying a foreign market cannot be burdened with restrictions that do not apply to companies not piping gas out of the State.

The suit was brought by a number of manufacturers in the Indiana gas belt, and was based on an act passed in 1889, which declared it to be unlawful for any person or company to pipe or conduct natural gas from any point within the State of Indiana to any place without the State.

The act further provided that a violation of its provisions should work a forfeiture of all gas leases held by the offending company, and all land it might have appropriated for pipe lines, and should make the officers and agents who were responsible for the offense liable to a fine of not less than $100 nor more than $1,000.

This act has been pronounced unconstitutional by different attorneys, but no attempt which has ever been made to enforce it in the 12 years that have elapsed since it was enacted has resulted in securing an opinion of the Supreme Court as to whether or not the law is constitutional until to-day, when it was declared invalid.

Chief Justice Dowling delivered the opinion of the Court, and, after reciting the allegations of the complaint, and stating that the object of the suit was to prevent the piping of gas from the State, said that the piping of gas out of the State would undoubtedly be legal in the absence of restrictive legislation, but the Court had already held that the act under consideration affected interstate commerce, natural gas, when reduced to possession in reservoirs, being recognized as an article of commerce. Continuing, the Court said:

"To the extent that the act of March 9, 1889, attempts to prohibit the owner of natural gas, which has been reduced to possession by proper and lawful means, from transporting it by safe and reasonable vehicles or conduits out of the State of Indiana, it contravenes the provisions of the Federal Constitution relating to interstate commerce, and is therefore void. No other foundation for the claim for the appellants to relief by way of injunction being disclosed, the complaint must be held insufficient."

Notes on Purifier Construction.

[A paper read by MR. G. P. LEWIS, of Lower Sydenham, at the November meeting of the Southern District Association of Gas Engineers and Managers, England.]

The mode of construction of dry purifier boxes has, until a comparatively recent period, generally followed the lines adopted in the very early days of gas manufacture. The only improvement calling for special mention is the substitution of india rubber joints for the cumbrous water seals in vogue for so many years. This use of the former system of jointing, though originally proposed many years ago, remained practically in abeyance until it was employed on a considerable scale by Mr. Green, of Preston; since when it has been freely adopted by a number of engineers. The system of jointing has been proved to be thoroughly successful in practice when properly designed, and results in a considerable reduction in the weight of the boxes and covers—amounting, in some cases, to about 20 per cent.

One of the disadvantages of the water seal system lies in the wastage of the lute plates and side sheets of the cover at the water line; the effects of this evil being so great as to render the use of cast iron for the lute plates almost a necessity, while, on the contrary, wrought iron or steel is equally suitable for the construction of purifier boxes on the dry-jointed system. Among other points, the problem of designing cast iron side plates with water lutes calls for some attention, as although at first sight this may appear to be a very simple operation, it is really a matter that requires some degree of experience; these plates being subjected to severe strains, due to the combined action of the outward pressure of the gas and the upward pull of the cover, also due to the same force. The general nature of these stresses is illustrated in Fig. 5; the greatest strain being in the neighborhood of the point marked *A*. If care is not taken to meet this strain by substantially bracketing the underside of the lute to the body of the lute plate, and also to provide proper internal ties, considerable trouble is experienced by frequent "cracking," and, as a consequence, leakage of water from the lute. On the contrary, the strains on the side plates are much less in the case of the "dry" joint—the "lift" of the covers acting almost as a direct tensile stress; while the multiple system of covers, usually associated with this method of construction, gives substantial cross-ties for resisting the outward pressure of the gas.

The fact that the side plates of dry-jointed purifiers are very much less severely strained than those with water seals, coupled with greatly reduced weight and a wider choice of materials, has led the author to investigate the possibility of improvements in the general construction of dry purifiers; and he ventures to lay before the members of the Association a few suggestions with the aforementioned object. It should be understood, however, that these suggestions more particularly refer to the construction of purifiers and purifier houses on the overhead system. The general lines of the proposed improvements will be most readily apparent by reference to the diagrams accompanying this communication, from which it will be seen that the main feature of novelty in the proposal lies in the idea of making the boxes not only support themselves, but also contribute to that of the upper revivifying floor and roof over same, coupled with a reduction in the weight of the pipe connections.

By reference to Figs. 1, 2 and 3, it will be observed that the purifiers are oblong in shape, and are arranged in consecutive pairs, side by side, with the greater dimension in the longitudinal direction, and the contiguous sides and ends connected together in such a way as to form "box-girders;" while the outer sides and ends are ordinary web plate girders. The bottoms of the purifiers are composed of wrought iron or steel plates, slightly dished for the purpose of drainage, and for reducing strains due to gas pressure. It is also proposed to stiffen up the sieve-bearing bars in combination with the general structure of the purifier, so that they collectively act as girders and struts for carrying the weight of material, and to prevent distortion of the girder sides. The purifiers are shown to be supported by short columns placed directly under the boxes; but they could be equally well carried on the outer sides, by prolonging the girders on to the walls of a building—the central columns only being retained.

The spent purifying material can be readily discharged through the sectional discharge outlet shown on Fig. 1. Each of these sections should be made light, so that it can be easily handled by two men, and provided with a padlocked, discharging door. It is also possible, with the system shown, to materially reduce the weight of pipe connections; and as these represent in ordinary practice from 9 to 30 per cent. of the weight of the purifiers and covers, it is evident that there is room for

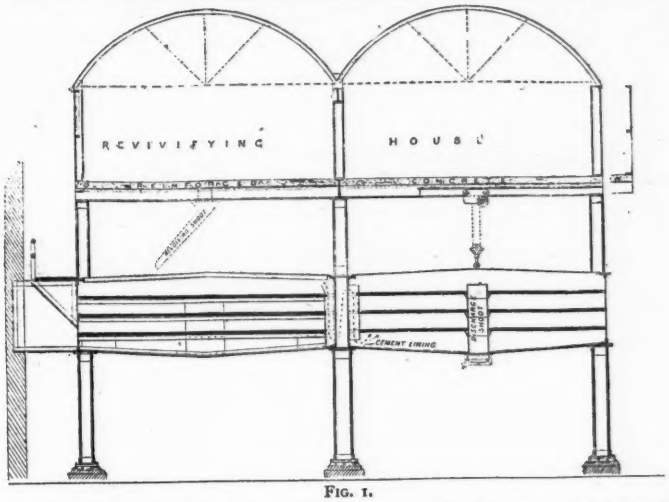


FIG. 1.

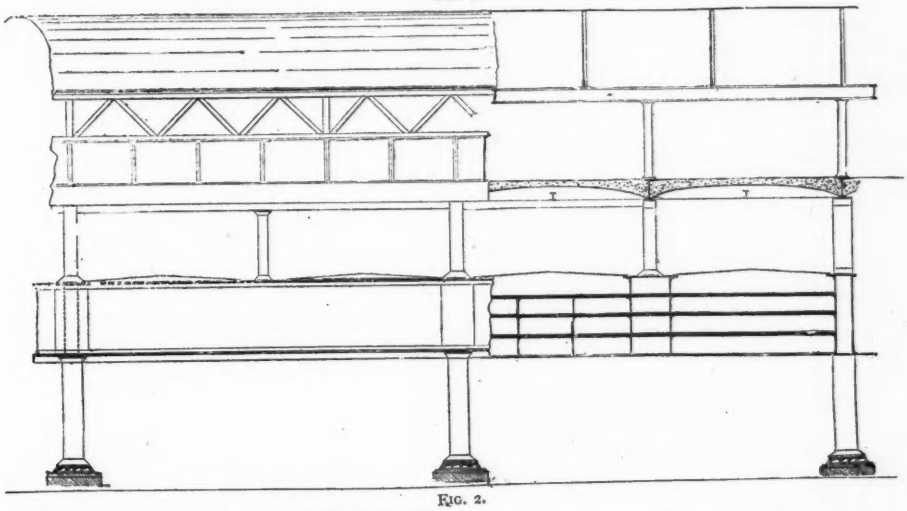


FIG. 2.

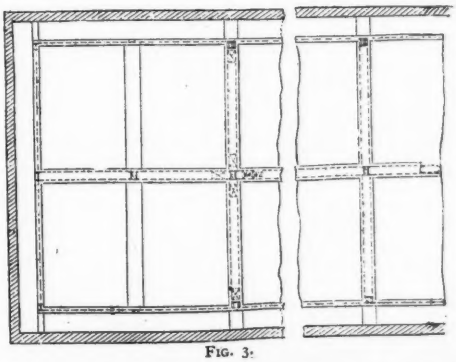


FIG. 3.

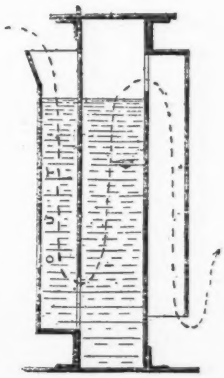


FIG. 4.

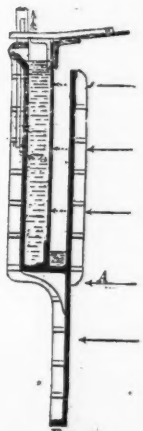


FIG. 5.

economy. By the aid of hydraulic valves formed in the body of the box girders, as shown in Fig. 4, and also by utilizing the space in the interior of the box girders as gas passages, it is quite practicable—assuming proper workmanship in erection—to work a set of four purifiers

on a rotation system, with a less extent of pipe connections than is necessary with an 8-way center valve.

The use of some system of reinforced concrete flooring, such as the Monier system, or the "expanded" metal form of construction for the revivifying floor, is recommended. Full particulars of the latter system are given in a paper by Mr. A. Baker, read before the Institution of Gas Engineers in May, 1900; and although it has only recently been introduced, it has been employed already at Beckton and other gas works for a similar purpose. The revivifying floor is shown to be inclosed by cast iron parapet plates, with a light single lattice girder secured to the upper flanges, for the purpose of carrying the roof principals. It is self-evident that the weight of metal in overhead purifiers constructed as described must be very much less than in any water lute system. It must be borne in mind, however, that cast iron plates cost only about one-half that of wrought iron or steel work, such as is shown. The degree of ultimate economy likely to be attained depends entirely on the skill of the individual designer; but the author is of opinion that the purifier boxes and covers *alone* can be erected for about the same cost as those of equal capacity on the ordinary water lute system, and that the cost of the supporting structure and connections can be reduced by an average of 50 per cent.

The author regrets his inability to give a greater amount of detail in the diagrams owing to the time for the preparation of this communication being somewhat limited.

The most complete and exhaustive system of sulphur purification, practiced almost exclusively to meet the regulations prevailing in London, remains in very much the same condition as when it was evolved many years ago. The author ventures to assert that very few of those who are, or have been, engaged in the practical working of the system will claim that it is an entire and economical success, and more especially under present conditions, when the gas manufacturer has perforce to be content with the supply of "all sorts and conditions" of a mixture called coal, giving a low yield of gas and residuals, but a very high one of other things, not the least of which are sulphur compounds and sulphuretted hydrogen. The introduction of air in purification has been of undoubted value in those happy places where sulphur clauses are unknown; but it is an unfortunate fact that it cannot be employed to the same extent under more rigorous conditions.

The hopes of the possibility of purification of gas in closed vessels, raised by the advent of the Claus process, still remain unfulfilled; and the "process" itself has apparently been relegated to the position of a thing of the past. The principle underlying the process, however—that is, "self purification"—still remains, and is worthy of attention. A study of the very able and candid account of the failure of the experiments on the Claus process at Belfast, given in a paper read by Mr. Stelfox before the Incorporated Gas Institute in 1897, gives a good clue to the defects in the mode of application of the underlying principle. The non-success of the experiments appears to have been quite as much due to mechanical and constructional defects as to chemical ones. There is no reason why the former could not be overcome at the present day; thus restricting the problem to one requiring chemical solution only. The latter is again reduced by the proved fact that the process was found to be quite capable of effecting complete purification for consecutive periods of two or three weeks.

The reason why the system was subject to fits of bad behavior has still to be solved, and deserves our attention. A perusal of the papers dealing with certain phases of this subject, by Mr. George Livesey and Mr. F. D. Marshall, read before the Gas Institute, in 1875 and 1878, respectively, sheds some light upon the phenomena. The author is of opinion that if some scheme of experiments could be initiated under the direction of a committee of practical men, a solution would be discovered.

Hill's liquor purification process in use at the Old Kent Road gas works for many years, and the more recently adopted Holgate's liquor purification system at Halifax, have proved successful within the limits of their application. Need we, therefore, despair of the devising of some intermediate scheme between the extreme pretensions of the Claus process, and the more modest aspirations of the two latter?

It may not be out of place, in conclusion, to express regret that very little progress can be claimed for improvements in the general process of purification.

THE people who own the Warsaw (N. Y.) Gas and Electric Company seem to be waking up, in that they propose to expend some money in plant betterment. Can it be that the Otis interest in the Warsaw concern has at last found the impulse that comes from the prod of a pin?

Coal Handling for Gas Works.

[An abstract translation from the *Journal für Gasbeleuchtung*, by MR. FREDERICK EGNER.]

At the Fortieth Annual Meeting of the German Association of Gas and Water Engineers, held at Mayence during the present year, Herr Weiss, Chief Engineer of the Municipal Gas Works at Zürich, read a paper on the subject named in the heading.

The matter of the paper, covering seven closely printed pages of our contemporary, contains interesting though lengthy details respecting the whole subject. In the course of his paper Herr Weiss shows that the handling of coal by mechanical means resulted in an economy of 46.5 per cent.

In a resumé the author gives the final results of his labor, and as the recapitulation covers the whole subject in concise form, the translator thought such would be sufficiently clear and altogether interesting enough to present to your readers.

The following are Herr Weiss's findings:

1. *Requirements.*—The transportation of the coal shall, after having been unloaded from the railroad, be done by mechanical appliances; hence, by means of a power plant.

2. As a source of power, gas, water, steam or electricity may be used; but the latter seems the more particularly suitable. For places charged with smoke and coal dust the electric motor is especially well fitted; further, it requires but little attention or supervision.

3. If cheap electric or water power is not at hand, it will be best to convert the coke breeze, by means of the Kudlicz or Perret grate under the boilers, into power, which will then be reconverted into electricity.

4. Only material in small pieces, such as slack or nut coal, can be satisfactorily transported by these methods. Lump coal must be broken before storing.

5. The mechanical appliances must combine strength of construction with simplicity in design, in order that they may be easily served by any workman. They should have but few parts subjected to any grinding action, and the lubricating features should be reduced to the least possible requirements.

6. All complication of apparatus should be avoided as much as possible.

7. The preceding condition at once carries with it the proposition that only benches with inclined retorts shall be used, because, along with the many advantages inherent to that system, they are the best suited to be employed in connection with such machinery as the above.

Along with the preceding remarks I refer you to the comprehensive researches of Herr Engineer Körting on that subject, given in a paper communicated at our Leipsig meeting in 1897. And to this I wish to add that to day, after having collected valuable experiences, and having had the most satisfactory results with inclined retorts, I cannot think anyone would now erect a medium or large sized works employing coal and coke handling machinery, without using the inclined retort as the connecting link. And not one of my colleagues who has ever operated with inclined retorts will doubt or question this assertion.

8. All methods of coal transportation should be furnished with some sort of a reserve, so that interruption of operation shall not be possible.

9. The coke leaving the retort can and should also be handled by machinery.

1. *Results.*—Entire independence from the good will or caprice of the workmen in conducting operations. During epidemics, war or strikes one can conduct the largest works with a small number of experienced men.

2. Simplifying operations, and, with greater security in operating, increased power of production.

3. Reduction in the number of workmen required, together with a reduction in the amount of physical exertion on the part of each workman employed. By these means the periods of rest of the laboring man are lengthened, because during a working-day he will be required to actually work only 5½ hours; and this again is likely to postpone the demand for the 8-hour day, called for by the socialistic labor element, for some years to come.

4. The real, or actual, gas workers (the firemen) will have nothing to do with manipulating the coal or coke, and can consequently give more attention to the heats of the benches.

5. At night the transporting of the coal (excepting into the retort) ceases. It is all done in the day time, and within a few hours.

6. Gas works with a minimum output of 106,000 cubic feet per diem can unhesitatingly adopt the mechanical coal and coke handling systems or process.

7. The construction of simple coal handling apparatus has been well shown as technically possible, and to be accompanied with very good financial results.

This communication embraces the result of thorough study of the subject. Many experiments and results, which exist not only on paper but have been well authenticated, demonstrate by practical operation with entire satisfaction for the past 2 years the benefit of coal handling at our works.

On the conclusion of his paper, Herr Weiss was thanked by the Chairman acting for the Association, for his comprehensive work, which had been prepared by request of said Association a year previous to the meeting.

One of the features which may be open to discussion is that which requires the breaking of the coal before storing. But Herr Weiss stated that it was simply a question of results after all. Viz., if the slightly lessened gas production from coal thus treated or the greater economy in handling effected, were the most valuable.

Another feature is the statement of the dimensions of works, which may undertake economically to handle coal and coke mechanically (see 6). And here I would add that because it is economical that inclined retorts 18 and 20 feet long may be used, there is no reason why 9 and 10 feet long retorts should not also be economical. Why not? Only not so much so as the longer sort. The short ones can be set in houses of lesser height, that is all. The writer used a bench of 5's, with 9 foot inclined retorts for over 2 years, with very good results.

The Design of Steam Power Plants.—No. VI.[1]

[By Mr. Henry C. Meyer, Jr., in *Engineering Record*.]

Drawings.—After contracts have been let for the engines, boilers, pumps, feed water heater and other auxiliaries of a plant, the engineer should obtain accurate drawings or blue prints of each, showing in plan and elevation the exact location of all steam and water inlets and outlets. When the engines, boilers and auxiliaries are located finally upon the plans, accurate drawings of the piping to connect them should be made. The piping should be shown in plan and in at least one elevation. The drawings should be to a scale of at least ½ inch to the foot, and should show the location of every fitting and valve in the system. It saves time to indicate a valve by drawing correctly the position of its flanges and joining them by two crossed lines. When a number of fittings are to be placed close together they should be drawn accurately and full, for if this is not done it may happen that the piping cannot be put together on account of too much being crowded into the space allotted. An accurate drawing would prevent an error of this kind from occurring. Complete drawings result in lower bids, and do away with extras that are usually the result of incomplete or inaccurate drawings.

Principles Involved.—The fundamental object to be accomplished in steam piping is, of course, to carry steam without excessive loss of pressure; and next in importance is the requirement of safety, that the condensation loss shall be a minimum and that the piping shall not leak. The greatest enemy to safety is the liability of water entering the system, or collecting in it, due to condensation; and it is, therefore, of particular importance that piping should be so constructed that it does not contain pockets in which water can collect. Pipes are usually proportioned so that steam travels at the rate of about 1 mile a minute, hence if a "slug" of water, as a body of water is sometimes called, is picked up by the steam and carried along with it an accident is very apt to occur, either by the rupture of an elbow, at a change in direction of the pipe, or by the water entering the engine cylinder and wrecking it. In some instances pockets cannot be entirely done away with, but where they do occur they should be properly drained. Straightway globe valves should not be used in a steam pipe, as the valve seat acts like a dam in forming a water pocket. Valves of any kind should never be placed so as to form a water pocket whether they are closed or open, if it is possible to locate them any other way. For instance, one frequently sees the stop valve on a boiler placed immediately above the boiler nozzle and a vertical section of pipe above the valve leading to an elbow from which a horizontal pipe leads to a steam main. When a boiler so connected is out of service, water due to condensation accumulates in the vertical pipe over the stop valve, and although the pipe may be provided with a small drain pipe and valve, experience has shown that the latter are not always made use of to draw off the water, so that an accident may occur. It is just as effective to use an angle stop valve at the top of the vertical pipe mentioned and to pitch the horizontal pipe that leads from it to the main so that condensation will flow toward the latter. With such an arrangement water cannot collect, and hence an opportunity for an accident does not exist.

Steam pipes should always be pitched so that the condensation that occurs in them will tend to flow in the direction in which the steam is moving, the reason for this being that if it is attempted to run condensation against the current of steam, water hammer is quite likely to occur, as the water accumulates into a slug, which is finally picked up by the steam and carried along until projected against a fitting. If one wants to carry steam a long distance, from one point to another at a higher level, the pipe should be laid at the inclination desired and at frequent intervals, say every 100 or 150 feet, the line should drop a few feet into a pocket that can be drained through a steam trap into a small return pipe running back to the boilers. A horizontal pipe should be inclined so that the condensation will tend to flow against the current of steam only when the pipe is excessively large, so that the velocity of steam flow will be much below the usual practice.

In systems of steam piping connecting several engines and the boilers supplying them it is usually the custom to connect each boiler with a steam main from which pipes lead to the engines. It is well to have this main of quite large size, so that the velocity of steam passing through it will be slow enough to allow any water that might be carried over from the boilers to accumulate in the main. The main, of course, should be drained by a pipe or pipes leading to a trap. If the main is divided into sections by valves, provision should be made for draining each section, for the reason that some parts may be shut off at times. Any branch to an engine should be connected to the top of the main to prevent, as far as possible, water from entering the branch.

It is impossible to give definite information as to the design of piping for all steam plants, for the conditions met with vary so much. With electric power house work, however, this is not the case, for the reason that the construction of these plants almost invariably follows one of two types that are standard as far as the relative locations of engines and boilers are concerned. These types are as follows: That in which the boilers and engines are placed back to back with a dividing wall between, and that with the boiler and engine rooms end to end, with the engines and boilers lying in the same direction. As far as the piping is concerned, the back to back type is the one most to be preferred, on account of the short and direct connection between the engines and boilers and the ease with which it can be enlarged. With the engine and boiler rooms placed end to end the condensation losses in the steam piping are greater, and this type of station, as far as the piping is concerned, is not easily enlarged.

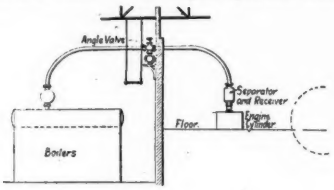
The steam piping for that type of station in which the engines and boilers are placed back to back and separated by a wall usually consists of a feeder from each boiler, connected with a main which is supported by the boiler room wall and also connected to each engine.

The engine room floor is usually a little higher than that of the boiler room. The main and as much of the piping as possible should be located in the boiler room, for the reason that if an explosion occurred in some section of the pipe in the boiler room, it would be possible after the steam pressure fell to cut out the damaged section and operate the rest of the plant. If the engine room, on the other hand, was the scene of the explosion and became filled with steam, the electrical apparatus would, in all probability, not be fit for service without considerable overhauling.

If the steam main is supported on a bracket on the boiler room wall, it is a good arrangement to carry a pipe with a bend of long radius from the nozzle of each boiler to an angle stop valve connected to a nozzle on the top of the main, as shown in Fig. 10, and to run a connection to each engine from a stop valve similarly located. The valve in the pipe leading from the boiler to the main should not be placed over the boiler nozzle and thus form a pocket, for reasons previously explained. With both valves close to the main they are easily reached from a light walk, suspended from the roof trusses. Another advantage of placing the valve close to the main is that the condensation is less when the valve is closed. Some engineers prefer to place the angle stop valve immediately over the boiler nozzle and run a horizontal pipe from it to an elbow turning downward to a nozzle on the top of the main. The stop valve can then be reached by a person standing on top of the boiler setting. The engine connection should also be a bend of long radius. These connecting pipes will then have sufficient elasticity to permit expansion and contraction to occur without injury to the pipe. With the arrangement suggested there is no chance of water collecting in any part of the system save in the main, and this should be large enough so that the water can settle there and pass out by the

1. *Ante*, p. 649.

drain pipes. Frequently the pipe leading to each engine is provided with a separator close to the throttle valve. Besides intercepting moisture in the steam the separator performs another function of great value, in that it provides a reservoir of steam close to the cylinder, which insures a higher and more uniform pressure in the cylinder up to the point of cut-off than there would be if it were omitted; and it also reduces the vibrations in the steam piping due to the intermittent flow of steam as the valves of the engine open and close. For these



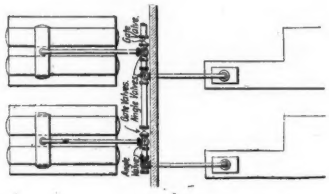


FIGURE 10.

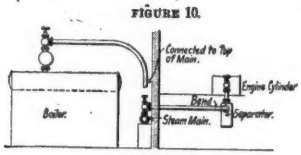
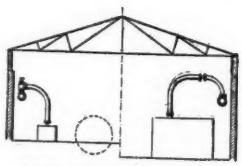


FIGURE 11.



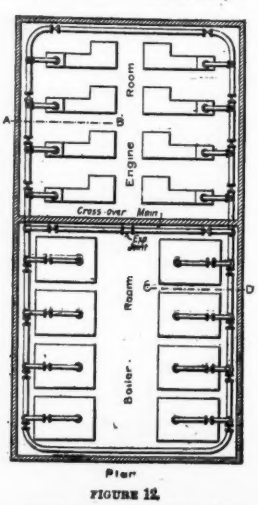


FIGURE 12.

Typical Arrangements of Steam Piping.

reasons a separator, particularly if of large volume, is of much value. When the steam piping in the engine room is run in the basement, the arrangement shown in Fig. 11 can be resorted to. There the main is close to the floor of the boiler room. It can be supported on piers or wall brackets. The stop valve on the boilers is placed on the nozzle and a pipe with a long bend drops into the top of the main. The branch to each engine is run from an angle stop valve on the top of the main to a separator near each engine cylinder. This system is as unlikely to have accidents occur to it as is the arrangement shown in Fig. 10.

Sometimes the steam piping is put in in duplicate, the two systems dividing at a double nozzle or Y on the boilers, and converging at a similar Y close to and connecting with the throttle valve of the engine. Duplicate systems were used much more frequently in the early days of electric power house construction than they are at the present time. In fact, the opinion is fast becoming universal that a duplicate system is an expense that is unnecessary with the arrangement of boilers and engines and piping shown in Fig. 10.

If the power station has the engine and boiler rooms placed end to end, as in Fig. 12, the arrangement of piping shown there is probably the safest. It is arranged on the ring or loop system, and valves are so placed that if an accident occurs, the damaged section may be cut out and the steam carried around through the system in the opposite direction. In the station shown an expansion joint is placed in the cross connection. In a station of any size the expansion in the mains running lengthwise of the engine and boiler rooms could be taken care of by anchoring the mains at the middle, so that the expansion would be equally divided between the two ends of the mains.

Exhaust Piping for Condensing Plants.—A frequent method of running exhaust pipes in condensing plants is shown in Fig. 13. Each

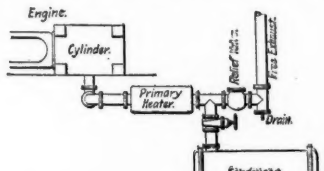


FIGURE 13.—Engine and Condenser Piping.

engine is supposed to be provided with an independent condenser and air pump. The exhaust pipe branches are shown, one branch dropping into the condenser and the other branch, which contains a relief valve, leading to the atmosphere. If advantageous to do so, the free exhaust pipes can be connected to a single pipe leading to the atmosphere. The purpose of the atmospheric connection is to provide means for allowing the steam to escape in case something happens to the condenser to prevent it from working. The relief valve is nothing more than a large check valve that is closed by the pressure of the atmosphere on one side, when a partial vacuum exists upon the other. Sometimes several engines exhaust into one condenser. The general arrangement can be the same. Exhaust piping for condensing plants should have flanged fittings most carefully put together. A leak through a very small hole will greatly affect the vacuum and the efficiency of the engine. The principal point to be looked after is to have the alignment of the pipe such that there is absolutely no chance for water to lodge in the piping system, for the reason that if the vacuum is suddenly broken, the water is apt to be sucked back in the engine cylinder and destroy it.

It is, of course, impossible to drain the exhaust pipe of a condensing engine, except toward the condenser, as the system is under a partial vacuum, unless some kind of positive pumping device, as an automatically governed pump and receiver, is used to drain off the condensation. One of the most important points is to have very generously proportioned exhaust pipes with as direct a run to the condenser and as few bends in the pipes as possible. The loss of a pound pressure between the engine and condenser means a very much greater increase in the amount of steam required to run the engine than would be occasioned by the loss of several pounds in the initial pressure, particularly with engines operating with low mean effective pressures.

Exhaust Piping for Non-Condensing Plants.—In non-condensing plants the exhaust steam can be carried long distances for heating or

for manufacturing purposes, provided the pipes carrying it are large enough. When exhaust steam is thus utilized, the pipe carrying the exhaust steam from the engines to the outer air, which is known as the atmospheric exhaust, or the free exhaust pipe, is provided with a back pressure valve, the function of which is to preserve a sufficient pressure in the exhaust piping to cause the exhaust steam to flow through a system of pipes, also connected with this free exhaust pipe, to the places where it is to be used. These back pressure valves are designed so as to open when the pressure in the exhaust system exceeds a certain amount, and thus allow sufficient steam to escape to reduce the pressure to that desired.

It sometimes happens when exhaust steam is used for heating or for manufacturing purposes, that the supply is not sufficient to meet the demand, and if this is likely to occur, it is the custom to run a live steam pipe from the high pressure piping to the exhaust piping, and to place in this connecting pipe a reducing valve which automatically opens and allows live steam to enter the exhaust system when the pressure in the latter falls below that which it is desired to maintain.

When a system for utilizing exhaust steam is employed, it is frequently arranged in the manner shown in diagram by Fig. 14. A

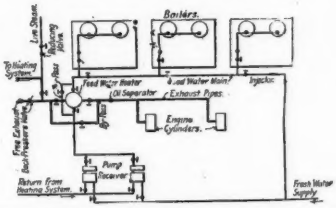


FIGURE 14.—Exhaust and Feed Piping for Non-Condensing Plant.

grease separator should be provided to remove as much oil as possible from the exhaust steam, after which the steam is passed through the feed-water heater. From the heater the pipe branches, one branch supplying steam for heating or for a manufacturing purpose—this branch furnished with a high pressure connection run from the boiler and containing a reducing valve. The other branch leads to the atmosphere, and it is provided with the back pressure valve. The top of the free exhaust pipe should have an exhaust head for intercepting the moisture that is blown out of the pipe by the exhaust steam. This head should have a drain pipe to a sewer or to waste.

Most power plants have a basement under the floor of the engine room, and in steam plants for buildings the exhaust piping is frequently run in covered trenches. When the exhaust piping is below the floor, a satisfactory method of connecting the feed-water heater is shown in Fig. 15. The steam may pass through the heater or around it through the by-pass by properly adjusting the valves.

Care of Drips.—The drainage from any part of the piping system is valuable on account of the cost of the water, and the heat in the water that would be lost if the condensation was allowed to go to waste. By condensation is meant water due to condensation in the pipes. Sometimes the saving that is due to returning high pressure condensation to the boilers is not sufficient to warrant the expenditure for the apparatus necessary to do this, but that is a point which must be determined for each case. Condensation from exhaust steam pipes can sometimes well be allowed to go to waste, for the reason that it generally contains more or less oil; and the chance of this doing injury to the boilers is apt to be too great for the saving that would follow its utilization. If it is used, the water should be filtered.

There are various methods of returning high pressure condensation to the boilers, and the most common are the Holly system and the "steam loop," both patented systems controlled by Westinghouse, Church, Kerr & Company, and by means of the automatically governed steam pump and receiver. With the latter the drip from all high pressure steam pipes, from separators, steam jackets on the cylinders, from reheating receivers, placed between the cylinders of compound and triple expansion engines, and all other points from which water is drained can be connected to a main leading to an automatic pump and receiver. Each drain pipe should have a steam trap, if there is any chance of their being under different pressures. The automatically governed pump can discharge the water into the boiler feed pipe between the boiler feed pump and the boilers. With very long steam pipes which have to be drained at several points, the drainage can be drawn off by a steam trap discharging into a return pipe leading to an automatic pump and receiver at the boiler house. If the inclination of the steam pipe is such that the water will not run back by gravity in the return pipe to the boiler house, the drip can be carried to the lowest point in the system and an automatic pump and receiver, operated by steam from the main pipe, can be located there and used to pump the water up hill and back to the boiler house; that is, of course, provided the saving will warrant this arrangement. All high pressure drip lines should be thoroughly covered with a non-conducting covering.

Low pressure drips contain the condensation drawn from pipes carrying exhaust steam, steam condensed in feed-water heaters of the closed type, the drip from engine and pump cylinders and the drip from grease separators. All of this condensation should be thrown away on account of the grease that it contains, unless some form of oil filter is used. All low pressure drips should be trapped independently into a drip main which can be led to any convenient place, such as the sewer, the pipe carrying off the discharge from the condenser, etc.

Feed-Water Piping.—Feed-water piping is sometimes put together with screwed and sometimes with flange fittings, and these are either of brass or cast iron. The pipe is of brass or extra heavy wrought iron. The screwed fittings are capable of standing a pressure of 150 pounds, but for pressures over 125 pounds flanged fittings are most frequently used. It is better to use elbows with a long radius to reduce friction. Gate valves should be used instead of globe valves, for the same reason.

An arrangement for feed-water piping for a typical plant equipped with surface condensers is shown in diagram by Fig. 16. The plant is

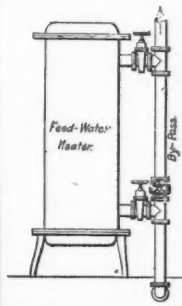


FIGURE 15.—Steam Connection to Feed-Water Heater.

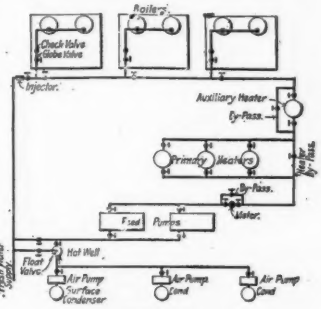


FIGURE 13. Feed Piping for Condensing Plant.

supposed to contain three engines, each with an independent air pump and surface condenser, two boiler feed pumps, a primary heater in the exhaust pipe of each engine, between the engine and condenser, and a single auxiliary heater receiving the exhaust steam of the air pumps and the boiler feed pumps. The steam condensed in each condenser is drawn therefrom by the air pumps and forced into a hot well, from which the boiler feed pumps draw their supply. For occasionally replenishing the water from the condensers and supplying fresh water when needed, a fresh water pipe is led to the hot well, and its supply can be controlled by a float valve or ball cock, so that fresh water will flow in the hot well in case the boiler feed pumps draw water faster than it is discharged from the air pumps. The boiler feed pumps are in duplicate. It is a good investment to put a water meter in the feed line, and one capable of measuring hot water should be used. The meter should have a by pass and be located at the pressure side of the pump, as shown. From the feed pumps the water is forced through the primary heaters and then through the auxiliary heater to the boilers. Each heater should have a by-pass, and in the pipe leading to each heater two valves should be placed, one used as a stop valve and the other as a regulating valve, which should be adjusted when the plant is started, so that approximately equal amounts of water will pass through the heaters. It involves a little more complication to do this, but it insures each heater doing its full work.

In Fig. 16 one end of the feed-water main in the boiler room is provided with an injector connected to the fresh water supply. The method of running feed mains in a boiler room varies. Horizontal tubular boilers are frequently set with a number of boilers in one battery. Sometimes, therefore, the feed main is run along the fronts of the boilers just above the fire doors. Water tube boilers are generally set two in a battery, so that if a pipe extends across the front it blocks the passageway between the batteries. With this type of boiler the feed main is sometimes run in a covered trench in the floor along the fronts

of the boilers. Again, the mains are run on top of the setting. A branch from the main should extend to the boiler front, at an elevation low enough so that the regulating valve, which should be of the globe type, may easily be reached by the boiler attendant. A check valve should be placed in the pipe, as shown.

Feed-water piping for non-condensing plants is shown in diagram in Fig. 14. It is supposed that exhaust steam is used for heating and that the condensation is returned to the boilers. This may be brought back to one of the boiler-feed pumps, which can be connected to a return tank receiving the condensation in the heating system. The pump draws water from the tank and forces it through the feed-water heater to the boiler. A fresh water pipe is led to the return tank and the supply is controlled by a float valve. If a feed-water heater of the open type is used, the condensation from a heating system is carried back to the heater, and usually enters it at the side or bottom. The boiler-feed pump draws its supply from the heater and forces the water to the boilers. Fresh water, controlled by a float valve or ball cock in the heater, is supplied to the heater at the top, and it falls to the bottom in direct contact with the exhaust steam and is thus heated. Cold water is only supplied when the boiler-feed pump draws the water from the heater so fast that its surface falls below a certain level.

In electric stations it is frequently the practice, for safety's sake, to use a duplicate feed main from the pump to the boilers. With such an arrangement it is possible to test a boiler or group of boilers. If the steam piping is arranged so that one or more boilers can supply any one engine independently of the others, the duplicate boiler feed main is of considerable value, for with such a duplicate system the steam used by an engine can be measured at any time and the condition of the engine determined.

Kind of Pipe.—"Extra heavy" wrought iron pipe is used for steam piping. In the connection between a boiler and a steam main, or the main and the engines, long bends made of wrought iron pipe are an advantage, for several reasons. First, they reduce the friction very much; second, their use reduces the number of joints likely to leak; third, such a connection is very much more flexible than one composed of two straight pieces of pipe connected by an elbow. Their greater flexibility is of great advantage in taking care of expansion after the piping is in place, and furthermore, they are much easier to connect when erecting the piping. No matter how much care is taken in facing the flanges off square, it almost always happens that the flanges of the boiler nozzles are not in perfect alignment, or exactly horizontal, so that a considerable strain is introduced in the piping in forcing the abutting flanges to a seat. It is much better to make the bends in the piping out of wrought iron than copper, although the latter has been used to some extent. At the temperature the copper is subjected to in brazing the joint, the fibrous nature that copper acquires in rolling is destroyed and a serious reduction of its tensile strength and ductility results.

Kind of Fittings.—There are two kinds of fittings used in steam piping, the screwed and the flanged fittings. The former, as the name implies, are put together by a screw thread, while the flanged fittings are bolted together. Screwed fittings are used in plants where the steam pressure is low, 80 pounds or under, and sometimes with higher pressures. The usual flanged fitting is shown in Fig. 17. The pipes are screwed into the flanges, as shown. Some years ago committees of the American Society of Mechanical Engineers, of the National Association of Master Steam and Hot Water Fitters, and of manufacturers of fittings, met and adopted a schedule for the dimensions of flanges, and this schedule is known as the "A. S. M. E.," or the "Master Steam Fitters" flange schedule. The schedule of standard flanges is printed in the catalogues of large pipe dealers and manufacturers. Flanges dimensioned in accordance with this schedule are considered by many to be strong enough for a steam pressure of 150 pounds, and even higher. There does not seem to be any doubt but that these flanges are strong enough for high pressures, but the careless manner in which they have sometimes been made and put together has caused leakage.

It is said that the bolt sizes here recommended are not large enough for high pressures, and it is the practice of several firms that make a business of installing piping for plants carrying high steam pressures to use bolts a size larger than is recommended in the standard flange schedule. In the best work the flange and pipe are carefully threaded and the pipe screwed into the flange. The inner circumference of the flange at the face of the flange is then struck with a hammer, or peaned, as it is called. The pipe and flange are then put into a lathe, where both are faced off. Sometimes the pipe is not screwed quite up to the face of the flange. Pipe over 16 inches in size cannot be threaded so the flanges are riveted on pipe over that size. Sometimes rivets are used with smaller pipe than that mentioned.

The difficulty with the flange shown in Fig. 17 is the tendency to leak throught the thread. This can be overcome by good workmanship, and one or two manufacturers have devoted a great deal of attention to making flanges of this type for high steam pressures. This type of flange is frequently put together with a copper gasket, either in the form of a flat or corrugated ring. There are various patented packings that have also given good satisfaction. In the flange shown by Fig. 18, which has been used with a good deal success, there is a circular tongue and groove, as shown, the groove containing a ring of copper as a gasket. One objection to this flange is that in places where the piping is concentrated and the connections short, it is difficult to spring the flanges apart a sufficient amount to take out a section of pipe for repairs.

The objection to any screwed flange is the tendency for steam to leak through the joint between the flange and the pipe. A method of overcoming the leakage between the flange and the pipe is shown in Fig. 19. The sketch from which the cut was made was furnished by Mr. George I Rockwood, Mem. Am. Soc. M.E., who designed the flange. The pipe is a steel boiler flue, and the flange is slipped over it, and the end of the pipe heated and flanged, as shown. The faces of the flange are cut away so as to caulk the joint. The Van Stone joint, made by the Walworth Manufacturing Company, is a modification of the Rockwood design, and has a recess in the flange in which the pipe is expanded as shown in Fig. 20. This joint has been used successfully to a considerable extent.

Cast iron has been used by some engineers. The stations of the Edison Electric Illuminating Company in New York City, recently absorbed by the New York Gas and Electric Light, Heat and Power Company, use cast iron almost exclusively, and with very satisfactory results. Mr. John Van Vleck, who designed the system, informed the writer that the piping was made of the best charcoal iron, containing 3 per cent. of aluminum to prevent blow holes from forming in the casting. The flange is cast on the pipe as shown in Fig. 21. The flanges have raised seats, and the joints are ground, no gaskets of any kind being used. In making these joints, a pipe was set on end and an iron strap put around the flange to be ground, so as to hold, in a proper position, the flange of the pipe or fitting to be ground to fit it. Emery was placed between the flanges, and the upper fitting turned by means of a stick of wood fastened to it, two men walking around with the stick until the joint was finished. Two men could grind a 14-inch flange in about half a day. The following table shows the sizes in inches of the cast iron pipe in the Duane Street station:

Inside Dia. Pipe. In.	Dia. Flange. In.	Dia. Bolt Circle. In.	No. and Size of Holes.	Thickness of Pipe. Inches.	Thickness of Flange. Inches.
16	26½	23¾	20 1⅛	1½	3½
14	24	20¾	16 1⅛	1⅜	3⅛
12	21⅝	18¾	16 1⅛	1⅛	3

This company used copper bends to connect the engines and boilers to the mains, but recently they have been using bent wrought iron pipe with the flange welded on the end of the pipe.

Wrought iron pipe with forged wrought iron flanges welded on the end of the pipe, shown in Fig. 22, has been introduced within the last year or two, and seems destined to play an important part in the steam piping of the future. The process of manufacture has been developed by the National Tube Company, which stated that in making the pipe a forged wrought iron flange is bored out and forced on to the end of the pipe. It is then heated in a furnace and welded by means of a hammer. The flange is then faced and the bolt holes bored out. The piping is usually put together with a corrugated copper gasket, and is made in various sizes from 6 to 36 inches in diameter.

Covering Pipes.—Steam pipes should be covered, for the double purpose of saving the latent heat in the steam that would otherwise be lost in condensation, and also to prevent the engines from being damaged by this water of condensation. With coal at $3 per ton, 10 feet of uncovered 6-inch pipe will cause an annual loss under average conditions of over $5 per year. A good covering that would reduce this loss to $1 per year would only cost about $5. From this it will be seen that it pays to buy the best covering obtainable, and in making a selection the question of durability should be looked into fully, as much as the efficiency of the covering when new. Sometimes the pipe covering is made part of the piping specifications, and again a contract is made for it with a manufacturer direct.

Specifications for Piping.—When an engineer prepares accurate scale drawings of the entire system of pipe fittings, etc., the written

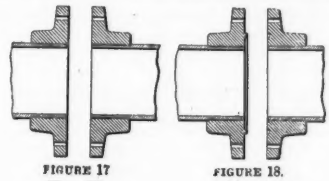


FIGURE 17

FIGURE 18.

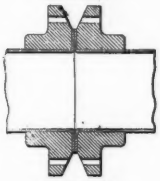


FIGURE 19.

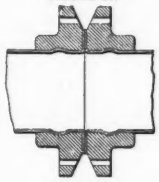


FIGURE 20.

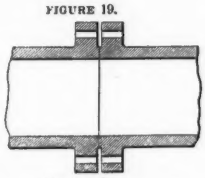


FIGURE 21.

FIGURE 22

Types of Flange Pipe Connections.

specifications can be quite brief. They should call for bids on the engineers' drawings, name the locality of the power house, ask of the contractor the time necessary to complete the work, and specify by name or make the following, if they are to be used, and are not marked on the drawings: Steam valves; water valves; reducing valves; back pressure valves; steam traps; injectors; kind of packing used between the flanges; kind of pipe covering. The method of supporting pipes should be described if it is not indicated in the drawings. The kind of fittings and pipe wanted should be clearly stated.

A Gas Engine Electric Lighting Plant in a Public Library Building.

Engineering News notes that in the branch libraries of the Carnegie Institute at Pittsburg, which have been established through the generosity of Mr. Andrew Carnegie, an extremely compact and efficient electric lighting plant has been adopted in which the dynamo that supplies current is driven by a direct connected gas engine. These plants were installed by the Westinghouse Companies, who furnished our contemporary with a description of the plant in use at the Lawrenceville branch, from which the following is taken:

The building contains an auditorium seating 5,000 people, a book room, with capacity for 60,000 volumes, and several reading rooms, etc. The building is lit by 200 incandescent lamps of 16 and 8-candle power. The engine room, located in the basement, is 15×18 feet, and contains the generating set, consisting of a 25 horse power Westinghouse 2-cylinder gas engine, direct connected to a Westinghouse direct current generator with a capacity of 150 amperes at 110 volts. The two machines are mounted on the same bed plate, only 4×10 feet. The room also contains the switchboard, and in one corner is a small air compressor, which is belted to the gas engine at intervals, as required, for charging a tank placed in a cupboard in the engine room. The tank is connected to the cylinders of the gas engine through suitable valves, and the compressed air is used for starting the gas engine, as is ordinarily done in the Westinghouse outfits. In the cupboard covering the air tank is a small primary battery and induction coil which is used for igniting the gas and air mixture in the engine cylinders while starting. After the voltage of the generators has reached normal, the igniting battery is switched out, and the main current from the dynamo is used in the ignition mechanism, 3 incandescent lamps in series being used as a resistance in circuit with the induction coil.

The plant has been in operation 9 months, and thus far no interruption of the service has occurred, no change in the igniters or any other part of the gas engine equipment having required repairs or renewal. The plant is in use for several hours every day carrying a considerable load, and it operates with great steadiness and a minimum of attention.

The building is heated by a hot water system using natural gas as fuel, and this gas is also used in the gas engine. Were fuel economy an object it would seem to be practicable to utilize the hot water discharged from the hot water jacket of the engine in the heating coils, thus obtaining the same advantage of economy as is obtained in the steam engine by the use of the exhaust steam for heating purposes.

The great advantage of the gas engine plant in the elimination of the boiler, with all its attendant risk, cost of attendance and dirt and dust in handling fuel and ashes, make the system an ideal one for isolated electric plants. The two features which have prevented a larger use of gas engines in this field are the liability to break downs and the noise and vibrations which were formerly considered inseparable from the gas engine. We are assured that these have been entirely overcome in the plant above described.

Production of Natural Gas in 1899.[1]

The total value of the natural gas produced and marketed in the United States in 1899 was $20,024,873, while that of 1898 was $15,296,813, showing a gain of $4,728,060. This gain is due in part to the slight increase in prices charged consumers and in part to the securing of more complete returns, but mainly to the increased amount of natural gas produced and marketed.

This gain has been accomplished against a declining pressure in all of the old fields. There was little new territory developed during the year, except in the extreme southwestern portion of Pennsylvania and a portion of West Virginia, in which some virgin territory that has not felt the drain of adjacent wells was developed. The increased delivery is due principally to the enlargement and multiplication of the pipe lines of the old companies, the application of the gas compressor on a large scale, and the more careful manipulation of the wells and lines so as to anticipate the requirements of the consumers.

West Virginia made the largest increase of any of the gas producing States. There were four large companies operating in the State during the year, which conveyed the product into Pennsylvania and Ohio for consumption. They are responsible for the large increase in the natural gas output of West Virginia.

The total number of wells producing gas reported at the close of 1898 was 8,453, and at the close of 1899, 9,333. This is an increase of 880 wells, or over 10 per cent. on the number at the close of the preceding year. The increase in the value of the gas sold during 1899 was 31 per cent. over 1898.

Of the total value of natural gas produced in 1899 the Appalachian fields supplied 60 per cent. and the Lima-Indiana fields 37 per cent., leaving but 3 per cent. of the value for the production of all the other fields in the United States.

The conditions under which natural gas is produced in the Appalachian and Lima-Indiana gas fields are somewhat similar, although in the first the gas is derived from a series of more or less porous sandstones, while the latter is found in the porous strata near the top of the massive Trenton limestone. The Appalachian sandstones containing the gas are found in the flanks and summits of long lines of uplifts in the strata. The gas of the Lima-Indiana field is collected along the flanks and summits of the gradual swells of the Cincinnati uplift. In the Appalachian regions there are a series of waves in the structure, forming high ridges with troughs or depressions between, known geologically as anticlinals and synclinals. These "rock waves" have greatly curved and gradually sloping flanks, and they follow a general northeast and southwest course to the west and northwest of the main Appalachian chain of mountains, and in a measure parallel with them. Beginning in Western New York, these parallel folds can be traced with some irregularities and modifications into Eastern Kentucky, crossing Pennsylvania and West Virginia, with outlying minor fields in Southeastern Ohio. In sections these parallel ridges are disturbed by cross anticlinals and the lines themselves are offset in several localities. The denudation of these uplifts has evened up the general surface, so that they are not usually prominent in the topography of the section.

The whole series, with their folds, have a general southwestern dip from Western New York to a point near Parkersburg, West Virginia, which averages 17 feet to the mile until West Virginia is reached where it flattens off. From this lowest point the measures are almost level for miles, gradually rising in all directions.

1. Abstracted from the 21st Annual Report of the United States Geological Survey.

Near the eastern edge of this level area there is a remarkable sudden uplift or anticlinal, extending almost due south from St. Marys, West Virginia, to Spencer, in Roane county, West Virginia, a distance of 40 miles.

On the flanks of these folds and at their crests, where the rocks are at the greatest elevation, the large reservoirs of gas are found. The main gas producing territory of the Appalachian region begins a few miles northwest of Parkersburg, and, with the exception of a few barren sections and offsets in direction, it is almost continuous in a northeast direction as far as Western New York. That portion to the southwest from Parkersburg, West Virginia, into Kentucky and Tennessee, is lacking in the regular structure of the section to the northeast, owing to the thickening of the measures below the Pittsburg coal, which has to a large extent counteracted the folds found on the surface. In this portion of the Appalachian field, however, there are some areas which are known to contain high pressure gas in considerable quantities. There are numerous sands covered up over this great area which hold both natural gas and petroleum. It is usually the position of the well with reference to the arch which determines whether it will produce gas or petroleum. Since the gas is very much lighter than petroleum, it is found in the higher portion of the same stratum, while the petroleum is contained in the lower portion, and salt water in and near the bottom of the trough. There are often exceptions to this, hpwever, which are generally accounted for by local folding or thickening of the strata in the floor of the trough or on the flanks of the uplift.

There are a number of sandstone strata that in different parts of the region produce gas. In a few localities three of the sandstone strata passed through by the drill are known to have produced gas in quantity, but usually the big flow found is confined to a single stratum. The strata which contain gas in quantity in different locations begin with the upper member of the Mahoning or Dunkard sands, at the bottom of the Barren Measures of the Carboniferous group, and end with the Kane sand of the Middle Chemung formation. The whole section represents a distance of about 3,500 feet of vertical strata, in which there are about 25 separate producing sands. They vary in structure from a dark red compact sandstone to sands containing beautifully rounded pebbles from the size of a pea up to a marble. The top portion of the sand is often very hard, compact silica. The open or pebble formotion is found below. The sand is usually covered with a compact slate or shale.

The following is a well record generalized so as to show the principal gas producing strata in Southern Greene county, Pennsylvania, and Monongalia and Wetzel counties, West Virginia, beginning with the Mapletown or Sewickley coal, which is assumed to be found at a depth of 720 feet :

Formation.	Top.	Bottom.	Remarks.
Conductor.....	0	16	
13¾ inch casing..	0	144	
10-inch casing..	0	1,148	
8¼ inch casing..	0	1,755	
6⅝-inch casing..	0	1,842	
5 3/16 inch casing.	0	2,204	
4½-inch liner in cave at 2,803..	2,803	290	
Sewickley coal..	720	725	
Pittsburg coal..	815	825	Produces gas in several localities.
Red cave.....	1,015	1,055	Near crinoidal limestone.

The gas regions in Ohio, known as the Sugar Creek and Lancaster pools, obtain their gas in the Clinton limestone, and are considered to belong more closely lo the Appalachian gas fields than to the Lima-Indiana field.

The natural gas produced in what is known as the Lima-Indiana field comes entirely from the Trenton limestone; not that the limestone in all localities holds the gas, for it is contained only in those parts of the field where natural reservoirs have been formed in the rock. A portion of the limestone areas in Ohio and Indiana has two or more strata near the top of the formation which are more or less porous or cellular, owing to the fact that the interlinking of the crystals of dolomite leave small spaces for the accumulation of the gas. Into these porous divisions, commonly termed "pay streaks," the natural gas has been stored under enormous pressure. There is a covering of compact shale, known as the Utica shale, capping the surface of the Trenton limestone, which has sealed in the accumulated gas.

The great Cincinnati arch, beginning in Tennessee, extends through Kentucky in a general northern direction, and crosses the Ohio river a few miles above the city of Cincinnati at an elevation on the crest of its anticlinal of 450 feet. The main crest then swings to the northwest with steadily declining elevation and with wide, gently sloping flanks passes into Indiana. At Hartford city, in Blackford county, its crest is at sea level and is covered by 900 feet of superimposed stratification and drifts. Very near the center of the north and south line forming the western boundary of Ohio an arm starts off from the main arch above described, pointing northeast, whose crest is subject to some undulations until at Findlay, Ohio, it has an elevation of about 315 feet below sea level at the highest elevation and is here covered by 1,100 feet of strata. At this point this arm forks, one limb pursuing a course nearly north as far as Sylvania on the Michigan border. The main arch continues its general course, reaching Lake Erie near Oak Harbor at an elevation of 725 feet below sea level and covered by 1,350 feet of strata.

On the Northern flank of the great broad swell of the main arch in Indiana, as well as along the declining crest of the arch toward the northwest, the great natural gas producing areas are located, and are estimated to contain 2,000 square miles. The area of gas producing territory in Ohio is estimated at 500 square miles; that at and near Findlay originally contained 100 square miles.

It must be remembered that while the greatest care is exercised in getting returns from all the companies supplying natural gas to consumers and from individuals using natural gas, and while over 95 per cent. of all the companies and many individuals have made full and complete returns, there is still a very considerable amount of natural gas that is not accounted for in this report.

Large quantities of gas are used by companies and individuals as fuel in the operating of pumps on small oil lines, pumping and drilling wells, the manufacture of lampblack, and for domestic fires for operators and land owners in the section where the wells are located. Natural gas needs no preparation to make it marketable, as does petroleum. This amount has been estimated at from 25 to 30 per cent. of the amount actually sold. There is also a large percentage lost, owing to leaks in lines, waste due to drilling oil wells in the gas territory, drips, and the blowing off of wells to exhaust the water that often finds its way into them. This is especially true of southwestern Pennsylvania and West Virginia, where there is at present much new work in progress. It is estimated that the average price of natural gas furnished consumers during 1899 was 18½ cents per 1,000 cubic feet.

There were in use, up to the close of 1899, 18,856.8 miles of natural gas mains of various sizes, from 2 inches up to 36 inches in diameter.

It is unfortunately true that both of the great gas producing fields, large as they once were, are approaching exhaustion. The greater portion of the Ohio division of this field, which originally had a rock pressure of 480 pounds to the square inch, has now no rock pressure whatever. A large area of the Indiana division has also yielded up over one-half of the volume of natural gas once stored in its great reservoirs. The original rock pressure in Indiana was the same all over the field, and registered 325 pounds to the square inch; it is now down to an average of 165 pounds to the square inch, and if 100 pounds is required to hold back the pressure of salt water, the figures show that 66 per cent. of the product has been taken out and consumed. The unjustifiable waste in all the natural gas fields has been enormous. Because of the original idea that the gas supply was inexhaustible, since one or two wells did not show any large decline in pressure during the first six months of their lives, and also because it seemed to cost the owners nothing after the well was drilled in, millions and millions of cubic feet of this valuable fuel were allowed so escape into the air unconsumed. Its value will only be realized after it is all exhausted.

All the fields show loss of pressure. The old field of Trenton rock gas in Northwestern Ohio is nearly exhausted. That of Indiana is undergoing a rapid decline. Many of the old fields have been practically exhausted in Pennsylvania also. Were it not for the fact that in Pennsylvania and West Virginia the gas areas are more or less separated by streaks of unproductive territory they too would have shown the same conditions that are observed in Ohio and Indiana. To reach the various gas pools of the Appalachian fields usually involves a complete change in the location of gas mains, which is a source of continual expense to the Eastern gas companies. The great, broad and almost continuous gas producing expanse of the Trenton limestone inside of defined limits have, however, made it a matter of simply lengthening the gas mains to reach additional territory.

THE authorities of La Porte, Ind., have about determined to go into public lighting on a large scale by means of Welsbach outdoor lamps. They will not make any mistake in so doing.

Gas Engine Questions.

Invention declares that the theory of the maximum expansion of the burning of gas is as old and well known as that of compression before firing, but has been neglected in favor of extending the latter one, for many reasons, of which the most cogent for engine builders is probably the following: The internal combustion engine, or gas engine only, as it was in its early days, was, for the power it developed, a bulky motor, and very wasteful of gas. When, therefore, the successful introduction of compression before expansion was an accomplished fact, a very much higher mean pressure, coupled with a great reduction of gas consumed, were the immediate results. The engine thus became much more powerful for its size, and also much more economical, and from that time, through becoming a rival of the steam engine in the lower powers, found a place in the market as an established commercial success.

The position to which the gas engine was thus brought presents some slight analogy to the change wrought in the steam engine as a practical —and at that time economical—motor by Watt. But it would, perhaps be premature to push the analogy further, and say that the improvements to the steam engine, resulting from higher pressures, and greater expansions, foreshadow the future developments of the gas engine. But even with the higher power which a modern gas engine possesses, it is still much below that of a steam engine when compared size for size; and as the cost of building is intimately connected with engine dimensions, and as greater expansion necessarily means a lower mean pressure and consequent increase in engine dimensions, it would want a very great gain in economy, due to this greater expansion and utilization of the burning gases, to induce manufacturers to add to the bulk or increase the complication of design of their engines for this purpose only.

The great virtue of the Otto, and its adaptation to commercial requirements, lies in the fact that the whole of the operations of suction, compression, etc., are carried out in one cylinder, and when the opposition to the introduction of the system of compounding in the steam engine is borne in mind, it is not to be wondered at that a similar dislike to any additions to the gas engine should be felt without having a certainty of very greatly increased efficiency.

It has been remarked by a well known writer on these motors that many of the early difficulties were experienced through endeavoring to carry out their mechanical details on lines similar to those of steam engines. It is true that, in the light of later experience, there has been some slight return to this idea in the construction of certain double acting and tandem engines; but the standard type of Otto engine shows that the simplest motor involves a very wide mechanical deviation from steam engine practice.

The failure of certain efforts to compound the gas engine probably arises more from an attempt to do so on steam engine lines, rather than from the more often alleged reason of insufficient gain from increased expansion to justify the addition of another cylinder, with its corresponding mechanical and thermal disadvantages.

The clearance volume in a gas engine cylinder is never less than 25 per cent. of the piston displacement, and very seldom as low as this. The number of times the gases are expanded when a full charge is drawn in does not, therefore, ever exceed five times. Between three and four times represents the average practice, and, although this ratio is by no means excessive, it yet represents a much greater difference between the maximum and mean pressure than would be the case in a simple steam engine which expanded its steam the same number of times.

There are two reasons which account for this: One being the different nature of the expansion curves; the other, and more important, being that in the gas engine expansion begins immediately the piston moves on its outstroke, while in the steam engine full pressure is maintained until the point of "cut-off," which determines the ratio of expansion, is reached. The mean effective pressure in the gas engine is also reduced by the greater work absorbed in compression.

To take full advantage of the gain by increased expansion, there are two ways open in gas motors, viz.: To carry it out in one cylinder only, or to take the course adopted in steam engines of compounding the cylinders, which latter method is, indeed, the only feasible one when it is desired to expand steam more than three or four times with real success. The first of the two methods is more promising of mechanical efficiency and, what is of greater consequence, of thermal efficiency also, for it must be remembered that cylinder wall action, so inimical to economy in steam engines, does not stand for the same thing in gas engines, where it is necessary to rob the gases of a large percentage of their heat to obtain suitable conditions for working. It also indicates the only direction which gives any hope of dispensing with the water jacket, for the fall of temperature in the gases takes place very rapidly as they expand.

It might be urged against the whole of the expansion taking place in one cylinder that the variation of load on the piston is already sufficiently great in gas engines without adding to it by still more expansion, but if the indicator diagram of ordinary practice is prolonged by plotting out the area due to expanding to, say, twice the volume shown, and then compared with its original form, it will at once be seen that the worst part of the diagram for excessive variation of pressure is the part exclusively used in practice, and that the area added on, while undoubtedly still further affecting the final ratio between maximum and mean pressure, does so at least without the excessive variations in its own pressures, which constitute the leading feature of the first part of the diagram. It follows from this that, even if the engine was compounded by the addition of a low pressure cylinder, unless a much larger clearance space, with the accompanying disadvantage of a lower compression of the charge, were given to the high pressure cylinder, there would still remain the great variation of pressure on the piston which already exists, because the exhausting pressure on the high pressure cylinder must fall to atmospheric pressure by the end of the stroke to permit of suction again taking place.

In the low pressure cylinder the conditions would more nearly resemble those in steam engines as regards admission and expansion, but the greatly increased wall surface, coupled with the more rapid fall in pressure, which is inherent in the expanding gases (their specific heat being only one half that of steam), puts a very severe check on this method of improving a gas engine. If it is necessary to use a water jacket on the low pressure cylinder to secure working conditions, its application in the ordinary way would so deprive the gases of their heat as to render their expansive power of little avail. These considerations, and the practical results which have attended them, appear more than anything else to have prevented the development of gas engines in this direction.

With one or two exceptions, all engines ignite the charge at a constant volume, the result of the indicator diagram being the vertical line showing the sudden rise of pressure which causes the heavy shocks in the engine at the commencement of the stroke. This practice is found necessary to obtain the longest possible time for expansion, for if the charge is ignited at constant pressure—that is, after the piston has commenced its outward stroke—the highest pressure attained (which is much lower than under the first named conditions) is not reached until about a third of thestroke has been accomplished. The amount of expansion is, therefore, much reduced, and the gases are discharged at a higher temperature and pressure, and frequently in flames. Such a result, while unquestionably improving the working conditions of the engine, is prejudicial to economy, and is only permissible where extreme smoothness of working is required. It is probable that were expansion under both these conditions of firing carried out to a greater extent, the respective efficiencies would present but little, if any, difference.

Our European Competitors in Iron and Steel.

Iron Age, in an editorial article that bristles with many sensible points, considering the things named in the heading, says:

Many writers who mix up patriotism and business, encouraged by the boasting of a few of our steel makers, are spreading the conviction that this country can undersell Europe at all times; that all that we need do is to make a bid for business and it is ours. Nothing could be further from the truth, and nothing is calculated, in the long run, to do the iron industry of the United States more serious injury.

To a very considerable extent our extraordinary progress in developing an export trade in iron and steel product is due to unprecedented and abnormal conditions in Europe. The works there have been overwhelmed with work, and their costs have suddenly risen in every department. One of the principal causes for the rise in costs has been the coal and coke famine of 1899 and 1900. On the Continent, and more particularly in Germany, it is merely a question of time when values for fuel will come back to a reasonable level, and so far as this question is concerned, no one who competes with English iron makers need hug the hope that high cost of coal is going to put the iron producers of that country at our mercy, bound hand and foot.

Anyhow, the question of cost of fuel in iron making is losing in importance quite rapidly. With by-product coke ovens utilizing their surplus gas and with gas engines converting the energy of the waste

gases of the blast furnace into power for driving steel works and rolling mill machinery, the consumption of fuel is bound to shrink rapidly.

With modern appliances and plant the day is not far off when the quantity of coal for steam raising and for reheating in steel works and rolling mills will become a negligible quantity. In other words, the 3,000 or 3,200 pounds of coal charged into the coke ovens will nearly suffice for the blast furnaces, the Bessemer plant and the rolling mill. This means that the districts the world over which now suffer from a high cost of fuel will steadily reach a better position. That the Continental iron makers realize this is evident from the fact that in Belgium and in Germany close to 150,000 horse power of large unit engines to operate with furnace gas are built or building, while with us, so far as we know, there is not a single one in operation. They are a long way ahead of us, too, in the introduction of by-product coke ovens.

In considering the position of our foreign competitors we must distinguish between three groups: 1. Those who depend upon ores brought to them by ocean carriers; 2, those located or near the interior ore deposits, and 3, those who are placed in proximity to the coal fields. To the first belong the littoral works of the Continent, whose number has been increasing, and such districts as that of the lower Rhine. In England it includes the Welsh and the Scotch districts, and to a certain extent the Cleveland district, all of them at the same time being located in the immediate neighborhood of coal or being very close to it.

All of the coast works have the advantage of being able to reach tidewater cheaply for shipments to all parts of the world. We might place in this class our own tidewater works like the Maryland and the new Dominion plant at Sydney.

The second group, depending upon local ores, has for most conspicuous representative the Minette district of Lorraine and Luxemburg, and the famous Cumberland district in England, the latter again close to the coast.

The third, located at the coal, embraces districts like those of the Black Country in England, the Saar, the Westphalian and the Silesian in Germany and the Liége and Charleroi districts in Belgium.

France, Sweden, Austria and Russia are negligible when dealing with the international situation.

We may waive any consideration of the advantages which these different producing regions command with reference to their own markets. But it is important to consider certain facts which bear upon the question whether our makers are so far ahead in their ability to produce cheaply. Turning first to the Cleveland district, it is true that pig iron has been made there in the past at $7 per ton, and there is no doubt that with modern improvements in coke oven and furnace practice now being introduced it can be done again. Middlesbrough has made steel rails at a little under $17 per ton from imported ores, and if the international ore markets get back to former conditions can do it again, and probably do better. Scotland cannot now make very cheap steel, but the use of the large quantities of splint coal in its blast furnaces is to a great extent counterbalanced by the recovery of ammonia and tar from the blast furnace gas. That the rich gas after going through the purifiers is wasted, as it is now, instead of being used to drive blowing engines or dynamos, is a disgrace to the Scotch iron makers. With modern improvements they should remain in the race. Some of the Welsh works have some very cheap coal and control rich ore deposits, notably in Spain.

On the Continent the Minette district, particularly if it gets reasonably cheap coal, can make basic pig at $7.50, and in the splendid new works ought to make billets at $12 per ton, or say $13 50 at tidewater, when the international squeeze should come.

Let us see where our plants stand by way of comparison; taking the figures as they were current in times of the greatest depression. Pittsburg, for example, has been credited with being able to make $7.50 Bessemer pig and $11 50 steel billets, or, say, $13 at tidewater. Birmingham may be able to get down to $6 basic pig or $11 open hearth billets. With $1 freight it could reach the sea at a total cost of $12 for billets. Where is the tremendous advantage of the American maker over his most favored rivals when the fact is considered that we are at a disadvantage in respect to ocean freights? On the face of it, it is not overwhelming, nor does it allow of any very sweeping claims to superiority, so far as the cruder forms are concerned.

This is true, however, that taking the bulk of the production in this country, it is nearer the minimum than it is in the case of the mass as compared with the favored few in Europe. In other words, there are entire districts in Europe and many plants even in the favored localities which our average works can beat handsomely in costs, so that a very large tonnage could be taken away from them without getting down to fighting costs. But it would be the height of folly to conclude that our assaults are irresistible, and that we will not be forced to do some vigorous and costly fighting. Our iron and steel makers will be called upon to make sacrifices even when the time has passed where they deem it expedient to underbid as fiercely as they have done in recent years. Fortunately the great consolidations are in excellent position to be the leaders in this struggle for a growing share of the world's markets.

Two Crane Company Novelties.

The Wm. M. Crane Company, of New York, has on the market several novelties, in respect of cooking apparatuses, which must favorably appeal to the owners or operators of "quick lunch" rooms. At this time of the year, and the "time" will last for quite something over 4 months, oysters cooked one way or another will appeal to the palates of many. There are many ways of cooking oysters, but it is proof on the real list to say that a broil, seasoned or unseasoned, will appeal to the appetites of the weak and of the strong; and the hotel keeper or restaurateur who uses a Vulcan oyster cooker from the Crane shops will have the comfort which comes from knowing that his guests are satisfied with his efforts, either from the sense of the palate or from the time that was not lost in waiting for the palate's satisfaction. We illustrate the No. C size, especially favored by the Crane Company on hotel account. The apparatus will, however, do more than broil oysters, for, according to the utensil placed upon it, one may have a fry or a roast. It will also "do up" potatoes,

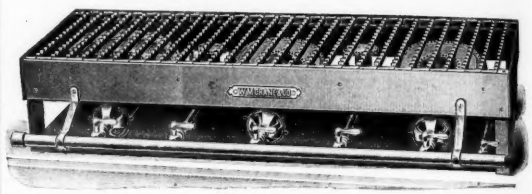


Fig. 1.

parsnips, and even oyster plants, etc.; in fact it is not beyond taking care of crullers, butter cakes, and the like. The consumption of gas is small, and the control of the heat is perfect.

Another Crane specialty is the "Manhattan Cooker," which affords a quick and accurate means of cooking a "cream of oysters"—otherwise a stew—in full view of the one who is to consume it. The provision is that the apparatus may be set fast, by screwing to the bar or lunch counter, while the stew pan may be moved on trunnions, with

Fig. 2.

the aid of the handle (see Fig. 2) to the right, which operation carries the pan into position for delivering its contents to the serving dish.

The Crane Company, whose address will be found in our advertising columns, will gladly furnish catalogues to inquirers.

Is the Problem of Aerial Navigation Solved?

Electricity remarks that opinions seem to be divided as to whether the problem of aerial navigation has been solved. Count Zeppelin, who, as is generally known, has been experimenting with his cigar-shaped navigable balloon near Friedrichshäfen in Germany, claims that it has, while many others, the Duke of Argyle among them, assert that the tests made by the German inventor signify little or nothing.

Immense sums of money have been spent during the past 100 years by enthusiastic inventors in trying to devise a body that would travel through space as a ship travels through the sea. It was early ascertained that the principal difficulty did not lie in lifting the mechanism from the surface of the earth, but in directing its course when suspended in the air. When the aeroplane was tried, the weight of the necessary machinery to guide and propel it against a moderate breeze, made it impracticable, while with the balloon the necessary weight could be raised, but the apparatus was too bulky to be driven or guided against the wind—at least until Count Zeppelin conceived the idea of a cigar shaped balloon ship.

In the experiments that have been made in this line electricity has played an important part, many believing that when the use of the electric current became perfected, the problem of what might be termed aerial propulsion would be easy of solution. Such proved, however, not to be the case, for the same reason that ocean going steamers are not electrically driven—namely, that the power derived was too small for the weight which it was necessary to carry.

By the use of benzine motors, exploded by electric sparks, Count Zeppelin has succeeded in propelling his 420-foot balloon ship against a moderate breeze and has also succeeded in making it perform evolutions, such as turning in a circle, twisting, rising and falling. In a recent trial the airship traveled 6 miles with the wind, which was blowing about 10 miles an hour, and then turned and without rising or falling from the stratum of air in which it was in, came back at a fair rate against the breeze. Count Zeppelin, as previously stated, considers the problem of aerial navigation solved, and expressed a belief that with a few improvements his ship will be capable of a speed of 30 miles an hour. On the other hand the Duke of Argyle, who is an authority, is reported as saying:

"I do not think that man can overcome the natural laws that condemn all buoyant bodies to an inertia that makes them useless. They must go with the medium in which they float. They cannot resist it, seeing they have no fulcrum to act on. * * * My own belief is, that if we are ever to navigate the air it must be on the mechanical principles which nature has adopted in her glorious and exquisite mechanism of avian flight."

This may possibly be so, but it cannot be gainsaid that Count Zeppelin has succeeded in driving and guiding his ship against the wind, a thing heretofore deemed well nigh impossible. We navigate the sea, and yet our ships are not propelled after the plan of fishes, and there would therefore seem to be no reason why we should not some day travel through space in the manner suggested by the German Count.

The Efficiency of the Bar Photometer with Mixed Coal Gas and Water Gas.

The *Gas World* reports that a debate on the named subject took place at a recent meeting of the Gas Engineering Society, London, England, Mr. G. P. Lewis presiding. Mr. E. D. Weippert, by whom the debate was opened said the original question sent to him was slightly different, from that with which it was now proposed to deal. It ran: "Is there any reason to suppose that with a mixture of carburetted water gas and coal gas, readings on the bar photometer are prejudicial to the quality of the gas? If so, explain the phenomenon." In the first place it must be remembered that the bar photometer (which, in this sense, included the "table" and all gas testing photometers on the Letheby-Bunsen or Rumford principles) was the ultimate court of appeal in all matters photometrical. Hence, when the bar photometer gave a certain value to a flame, that was the value of that flame, and any other value was fictitious, so that in a strictly photometrical sense, the question must be answered in the negative—that was to say, there was no reason to suppose that the readings were prejudicial.

But there was another aspect of the question. There was, he believed, a very general impression that neither carburetted water gas alone nor a mixture of the same with coal gas obtained justice on the photometer. The rich gas (25 or 30 candle power) might possibly suffer from being burned in an unsuitable burner and under conditions which did not bring out its full value, but such drawbacks would have no existence where a mixture of coal gas and water gas with an illuminating power of rather over 16 candles was under test. He believed himself that there was a good reason for this very universal impression, apart from any photometrical conditions, and that the reason was very simple. If a sample of 16-candle water gas was tested on the photometer it would be found that the length of the flame in the Argand burner was appreciably less than that of coal gas of the same power. This meant that the same amount of light radiated from a smaller surface, which had the effect of dazzling the eye of the observer and impressing him with an idea of high illuminating power. It was distinctly noticeable when water gas and coal gas of the same quality were being compared, that the water gas flame appeared to be superior to the coal gas flame; but, on the other hand, the coal gas flame lighted objects in the vicinity rather better than the water gas did.

The latter phenomenon was caused by the difference between illuminating power and illuminating effect, concerning which he would say a few words before he closed. It was, of course, understood that the two gases of which he had been speaking were exactly equal on the photometer, and he wished to make it quite clear than when there was only a small percentage of water gas present, the differences in appearance and effect would be so slight as to pass unnoticed, though they would exist in ratio to the percentage of water gas present in the mixture.

To deal briefly with the question of illuminating power and effect, it would, he thought, be generally agreed that a very large amount of light emanating from a small surface gave a very bad effect. In short, within very wide limits, it might be taken as true that the greater the surface from which a given quantity of light emanated, the greater would be the lighting effect. This extended surface could be obtained by using burners designed to produce it, by using a larger quantity of poorer gas, and, lastly, by using a greater number of burners, each of small candle power.

As an example, an ordinary dwelling room might be taken, lighted thus: (1) 1 incandescent burner, 60 candles; (2) 4 Argands (4 by 15), 60 candles; (3) 6 small flat-flames (6 by 10), 60 candles; (4) 30 wax candles (30 by 2), 60 candles. The effect produced would be found to increase with the number of separate burners or points of light.

In the sense, therefore, that a water gas flame being of smaller surface and greater intensity than a coal gas flame had an inferior illuminating effect, it might be said that the photometer gave more than its value to the water gas, but the preferable manner of stating the same thing was that its illuminating effect was poor compared with the photometrical readings.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Messrs. George B. Morley and J. M. Morley, of East Saginaw, Mich., have acquired a controlling interest in the capital stock of the Saginaw Gas Company, of West Saginaw, Mich. This means, of course, that the East and West Saginaw Gas Companies are to be united, and it is in every sense satisfactory to know that the union will be effected through the Morley family, whose steadfastness in their belief that there is money in gas is grounded on the knowledge that they are not the first of their generation who had to do with it.

Mr. Herbert H. Ferris, formerly with the New York Suburban Gas Company, has accepted a position in the service of the Hudson County Gas Company, of Hoboken, N J.

We understand that the Seattle Gas and Electric Company, of Seattle, Wash., will lose the services of its clever and capable Secretary and General Manager, Mr. C. R. Collins, whose resignation has been tendered, to take effect the last of this month. Perhaps the owners of the Company are suffering from an excess of nervous executive ability. Whether so or not, the cold fact remains that, under the management of Mr. Collins, the Company went on from bad to good, as its records before and after his direction of its affairs will readily prove.

The Town Council of Hanover, Pa., has assented to the renewal of the franchise of the Hanover Gas Company. This result is mainly attributable to the diplomatic efforts of Mr. George N. Forney, and is the forerunner of important changes respecting actual ownership in

the Company. A further interesting thing is that the change foreshadows fresh moves in the matter of bettering the gas supply of the district, through plant improvement.

THE Westchester Lighting Company, which is the absolute owner of the existing franchises for the supply of gas and electricity on lighting account in Westchester County, N. Y., has filed a certificate announcing that its capital stock has been "adjusted" in the sum of $12,500,000. It has many valuable lighting properties under its control, among which may be mentioned those of Yonkers, Mount Vernon, New Rochelle, Rye and Portchester, etc.

THE Royal Gas Light and Power Company, with a capital of $100,000, has been organized by Messrs. George C. Goodrich, F. Primrose, F. T. Harrison, H. W. Royal and W. B. Brown, all of Baltimore city or county, Md. The ostensible purpose of the corporation is "the manufacture of all kinds of lighting machinery."

MR. OSCAR GOLDSMITH has been elected Secretary of the Huntsville (Ala.) Gas Light Company, vice the late Col. Robert M. Coxe.

THE Steelton (Pa.) Home Gas Company projectors are ready to go on with their enterprise. Mr. Avery C. Sickles, of New York, seems the leading man in the affair, and it is certain that, whether or not he continues to be concerned in the physical management of the plant, a gas works is to be built at Steelton. Mr. Sickles has as associates Dr. Dickinson and Messrs. J. G. Diffenderfer and J. C. Durbin.

THE American Bridge Company is furnishing from one of its Chicago plants 36 plate girder spans for the Rio Grande (Western) Railroad Company.

UNDER the proposals submitted for the public lighting of Minneapolis, Minn., for the ensuing year, the charges therefor are likely to be as follows: On gas account, $1 per 1,000 cubic feet supplied, plus $4 each per post per annum on maintenance and repair charges. Electricity account, 174 arcs, all night schedule (to aggregate 3,500 hours), 3.1 cents per hour; 600 arcs, moon table (to aggregate at least 2,000 hours), 4.1 cents per hour.

WE regret very much to have to report the death of Mr. Frank J. Timmons, Secretary and Treasurer of the St. Catharine's and Welland Canal Gas Light Company. His death occurred as the sad sequel to an illness that lasted for a long time. He was very well liked by many gas men whose homes border on the great lakes. The correspondent who forwarded us the knowledge of Mr. Timmons' death closes his note in the remark: "He was well thought of by us all."

THE City Gas Trustees, of Toledo, O., who are concerned in the sale of natural gas there, have put out the following announcement in respect of the rates that are to prevail in such respect, "until further notice:"

Resolved, That, commencing December 1, 1900, the price of gas shall be 32 cents per 1,000, with a discount of 2 cents if the bills are paid within the first 10 days of the month following the month in which the gas is used, and that no gas will be supplied after January 1, 1901, except by meter measurement as the city now has to buy all gas used, and that postal notices of this resolution be mailed to all consumers.

THE above recited action must cause Mr. Faben and his associates to ask themselves, "Who are the people?"

THE Sterling White Lead Company, of New Kensington, Pa., has placed an order for its "seven" new buildings with the American Bridge Company.

THE Consolidated Electric Light, Gas and Power Company, of Woodlands, Cal., is making sensible addition to its storing capacity. Had its owners taken such precaution at the outset, for at no time was its storage provision equal to half what it should have been, they would now be in much better fix than they are, and the cost of the earlier providing would have been about one-half of the charge that their present expenditure will be.

"OUR own" Colonel Frank S. Richardson, the directing genius of the North Adams (Mass.) Gas Light Company, has been informed by the Board of Gas and Electric Light Commissioners that his application for an increase of $50,000 to the Company's stock has been allowed. We believe and hope that Col. Frank means to put the results of this increment into the gas end of his trading. However, no matter what he does with the sum, we know that it will be expended wisely and well.

THE long fight over a renewal of the franchise of the Covington (Ky.) Gas Light Company seems to be ended, the victors being President Shinkle and his redoutable aide, Mr. J. W. R. Cline. Under the agreement, the Company secures a 20-year franchise, from October, 1902, with the right to charge a maximum selling rate of $1 per 1,000 cubic feet. So, good-bye to Mr. Detweiler and his associates. The credit for this result is by all odds to be given to Mr. Cline, who seems to have the ability to preach the text that was read to him many times by Governor Bushnell.

MESSRS. J. H. WHITTEMORE, A. H. Dayton and H. H. Squire, have announced their intention of applying to the forthcoming General Assembly of Connecticut, for a charter to place, operate and maintain a gas works in Naugatuck. Undoubtedly there will be quite a bit of contention over this application, for the Naugatuck Electric Company, which, through the virtue of its original charter, had the right to supply gas in Naugatuck, has been absorbed by the Connecticut Lighting Company. In any event the fact remains that no gas supply can be had in Naugatuck, and the place is large enough to have such service.

MR. E. G. COWDERY, whose mouth is the despair of dentists, will likely have much trouble on his hands at the outset of the new century; for his directors have about decided that the big storage house of the Milwaukee Gas Company, at St. Paul avenue and 24th street, looks lonesome without the concomitants of such a vessel. To put it, plainly, the Milwaukee Company proposes to construct a new works on the site named, the building thereof to be commenced next spring.—B.

IN the initial trial of the case of Lee Roberts vs. the Fargo (No. Dak.) Gas and Electric Company, which suit was brought to set aside the Company's contract with the city for street lighting, Judge Pollock sustains the Company's contention. The contract was to cover a period of 10 years, and the Roberts' plaint was that the covenant was void in that it pledged a certain portion of the city's revenues for the term named. Broadly, Judge Pollock declares that the contract was made in good faith, and that both parties are bound by its terms, until either fails to live up to its agreement. We hope to give the full decision later on, and certainly shall do so if the Company will forward us a certified copy of the opinion. It is an important case, so far as contracts go in the named State. An appeal to the Supreme Court is to be taken.

A CORRESPONDENT forwards the following: At a meeting of the Board of Directors of the Peoples Gas Light Company, of Rutland, Vt., held in the last week of November, the following resolutions were adopted, respecting the memory of Mr. John W. Cramton:

"*Whereas*, It has pleased Almighty God to take from our midst our late associate, John W. Cramton; be it, therefore,

"*Resolved*, That we, the Board of Directors of the Peoples Gas Light Company, in recognition of the noble qualities of mind and heart that distinguished and endeared our late associate to us, extend to the family of the deceased our most sincere and heartfelt sympathy. And be it

"*Resolved*, That the Secretary is hereby ordered to make a record of the foregoing resolution, and that a copy of the same be sent to the family of the deceased.

"GEORGE H. VERDER, President.
"F. A. FIELD,
"J. C. DUNN,
"A. H. KEYES,
"H. R. KINGSLEY, Secretary."

WE understand that Mr. Phillip Cross has been appointed Manager of the sales division of the Denver (Col.) Gas and Electric Company.

A BASE measuring apparatus, which has been perfected in connection with the summer school work of the Civil Engineering Department of the Massachusetts Institute of Technology for a few years has recently been tested by the Coast and Geodetic Survey in Washington. Such satisfactory results have been already obtained and others assured that the apparatus is about to be used in the important Lampasas Base in Texas. Professor Burton of the Institute, under whose direction the apparatus has been worked out, has been invited to accompany the expedition which is to make a careful trial of the method in the field and upon extended exact work. The apparatus represents the final results of thesis investigations by several graduates of the Course in Civil Engineering who have worked upon it in successive years. One part of the apparatus maintains a constant tension in the steel tape while in use. Another part of the apparatus determines very accurately the mean temperature of the tape by measuring its electrical resistance by means of a special form of thermophone devised by two graduates. The complete apparatus is not bulky and is of high value for exact measurements.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO., PROPRIETORS.

THOS. J. CUNNINGHAM, ELBERT P. CALLENDER, EDITORS.

CHAS. E. SANDERSON, MANAGER.

PUBLISHED ON EACH MONDAY OF THE YEAR AT No. 32 Pine Street, New York.

The JOURNAL is the official organ of the
NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.
AMERICAN GAS LIGHT ASSOCIATION.
WESTERN GAS ASSOCIATION.
OHIO GAS LIGHT ASSOCIATION.
PACIFIC COAST GAS ASSOCIATION.

TERMS:

SUBSCRIPTION—Three Dollars per annum, in advance. Single copies, 10 Cents.

Notification Respecting Advertising.—Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

MONDAY, DECEMBER 10, 1900.

The Market for Gas Securities.

The market for city gas shares was quite eccentric last week, and the mean result was a decided lowering in quoted values. Consolidated opened to-day at 189½, bid, ex dividend of 2 per cent., and the close was made at 188⅛ to 189. There is no reason for the decline. On the contrary, excellent reasons for an advance exist, for the Company's position in respect of the mobilization of its forces is advancing every day. Mobilization in the sense that it is here used means retrenchment as to expense, and increase as to revenues. The growth of its business is little short of remarkable.

Brooklyn Union is steady, but the trading in it is virtually nothing. Peoples, of Chicago, is somewhat weaker, the decline having occurred on a fairly large volume of trading. Bergen County (N. J.) gas, as it is now called, is being inquired for, but the astute gentlemen who control its fortunes are not inclined to let much of it go at less than 80; they will get more than that for it as soon as they are ready to dispose of a controlling interest. Consolidated, of Baltimore, is steady at last week's figures. It is worth 70. United Gas Improvement Company, of Phila., is cheap at the bid price of 124. The demand for gas bonds is very much in evidence.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

DECEMBER 10.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$54,595,800	100	189½	189¾
Central Union, Bonds, 5's.	3,000,000	1,000	106	107½
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,500,000	1,000	120	..
Metropolitan Bonds	658,000	..	108	113
Mutual	3,500,000	100	398	403
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. .. Bonds, 5's	11,000,000	1,000	108¼	109
Northern Union, Bonds, 5's.	1,250,000	1,000	104	104¼
New York and East River . Bonds 1st 5's	3,500,000	1,000	103	103½
" 1st Con. 5's	1,500,000	..	113	.
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	.
Standard	5,000,000	100	130	133
Preferred	5,000,000	100	150	153
Bonds, 1st Mortgage, 5's	1,500,000	1,000	110	114
Yonkers	299,620	500	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	175	180
" " Bonds (5's)	15 000,000	1,000	116	119
Bay State	50,000,000	50	1	1¼
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	80	40
" 1st Mtg. 5's	475,000	1,000	96½	99½
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	7	9
" " Bonds, 5's	5,250,000	1,000	68	71
Capital, Sacramento Bonds (6's)	500,000	50	..	35
	150,000	1,000	..	..
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati G. & C. Co.	8,500,000	100	194	198
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,907,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,720	100	60	65
Preferred	3,036,500	100	84	86
Consumers. Jersey City Bonds	600,000	1,000	102	105
Consumers, Toronto	1,700,000	50	215	216
Consolidated, Baltimore	11,000,000	100	59	59½
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 5's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N. J.	1,000,000	100	10	17
" Con. Mtg. 5's	380,000	1,000	80	85
Consolidated G. & E. Co.'s, Little Falls, N.Y. Bonds	90,000	100	..	100
	75,000	..	..	100
Detroit City Gas Co.	4,560,000	50	95	97
" Prior Lien 5's	4,598,000	1,000	99½	100
Detroit Gas Co., 5's Inc. 5's	386,000	1,000	100	101
	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	35	40
Fort Wayne	2,000,000	..	35	41
" Bonds	2,000,000	..	60	64
Grand Rapids Gas Lt. Co. " 1st Mtg. 5's	1,000,000	50	100	105
	1,125,000	1,000	..	..
Hartford	750,000	25	240	250
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	60	70
" Bonds, 6's	2 650,000	..	98	100
Jackson Gas Co. " 1st Mtg. 5's	250,000	50	70	75
	250,000	1,000	101	103½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,322,000	1,000	101½	103
Laclede, St. Louis	7,500,000	100	69	71
Preferred	2,500,000	100	95	100
Bonds	10,000,000	1,000	107	107½
Lafayette Gas Co., Ind. Bonds	1,000,000	100	40	50
	1,000,000	1,000	60	65
Louisville	2,570,000	50	110	120
Madison Gas & Elec. Co. " 1st Mtg. 6's	400,000	100	70	75
	250,000	1,000	102½	108
Montreal, Canada	2,000,000	100	182	184½
Newark, N. J., Con. Gas Co Bonds, 6's	6,000,000	..	..	55
	4,000,000	..	..	103
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal. " Bonds	2,000,000	..	46	47
	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	97¾	98
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	90¾	91
2d "	2,500,000	1,000	104	105
Rochester Gas & Elec. Co. Preferred	2,150,000	50	86	..
	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	47¾	47½
St. Paul Gas Light Co. 1st Mortgage 6's. Extension, 6's. General Mortgage, 5's.	1,500,000	100	47	05
	650,000	1,000	82	85
	600,000	1,000	..	..
	2,425,000	1,000	98	90¾
St. Joseph Gas Co. " 1st Mtg. 5's.	1,000,000	100	81	84
	750,000	1,000	98½	98
Syracuse, N. Y. Bonds	1,750,000	100	9	10
	1,612 000	1,000	88½	93
Washington, D. C First mortgage 6's	2,000,000	20	273½	275½
	600,000	..	..	..
Western, Milwaukee Bonds, 5's	4,000,000	100	95	98
	3,830,500	..	107	107½
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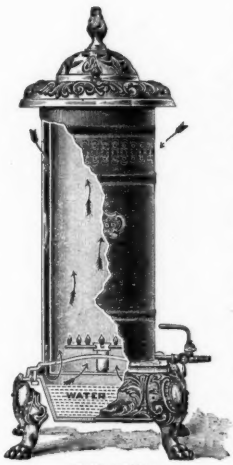

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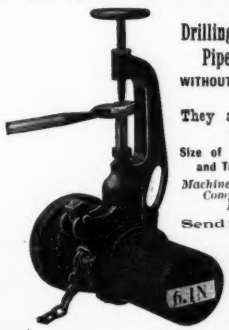

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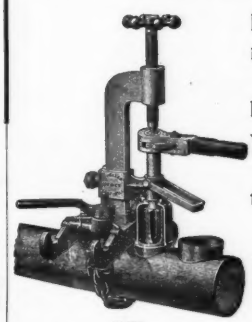
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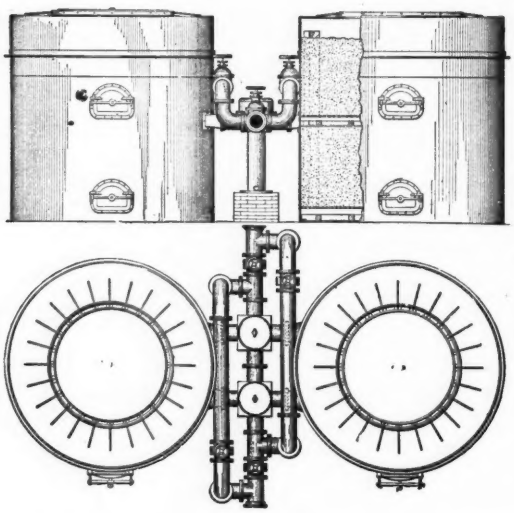

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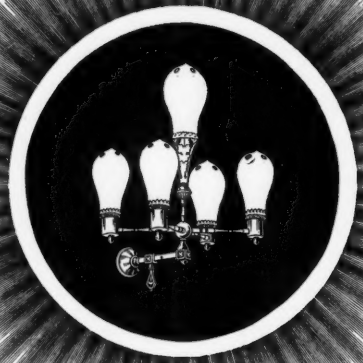

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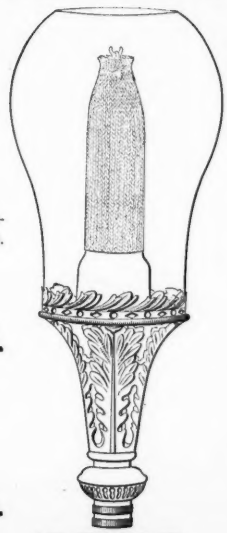
"	3	"	3	"	105	"
"	4	"	4	"	140	"
"	7	"	7	"	225	"



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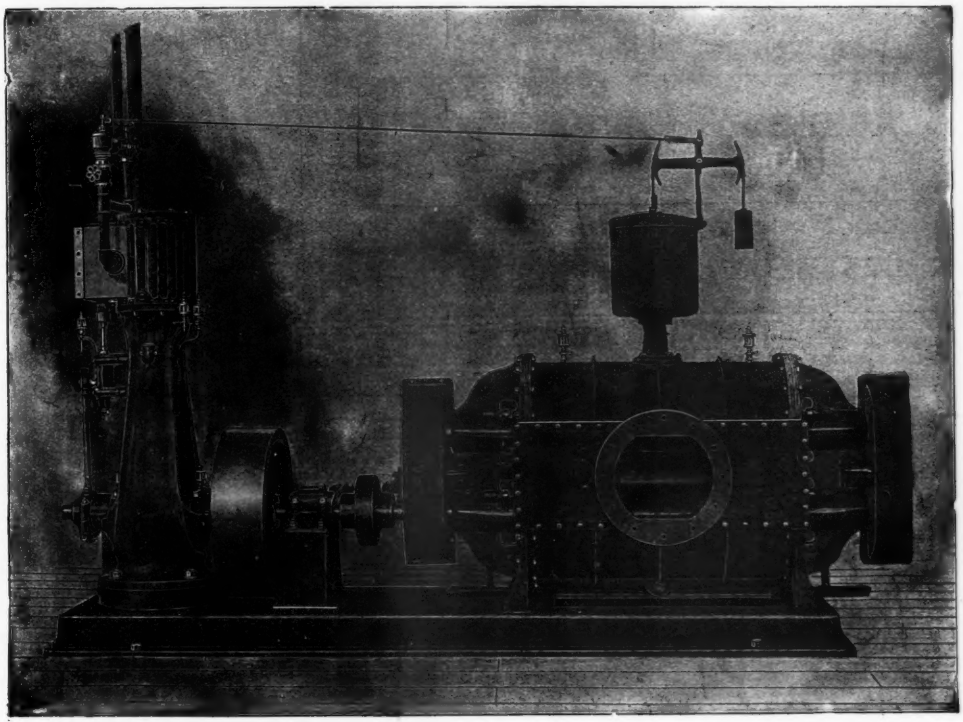

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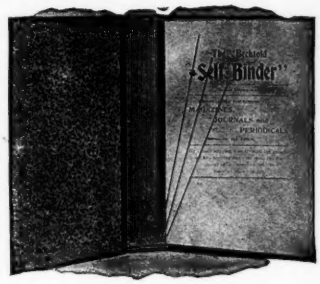

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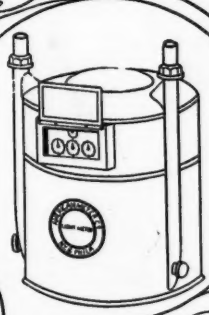
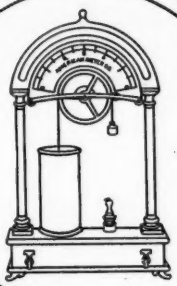
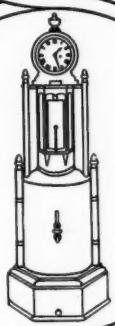
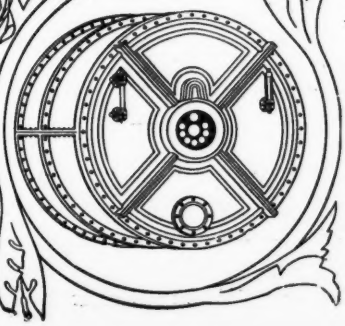




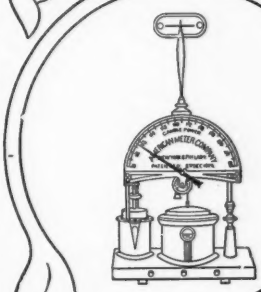


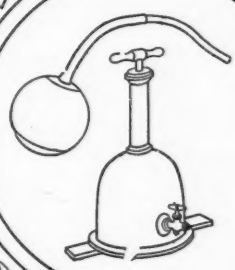


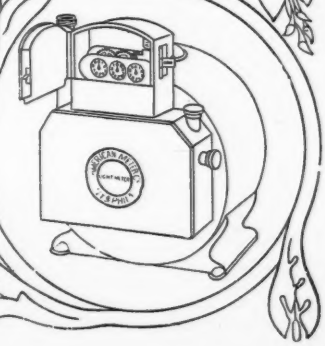
PUBLIC LIGHTING TABLE.

DECEMBER, 1900.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Sat.	1	1.30 AM	6.00 AM	4.20	6.10
Sun.	2	2.40	6.10	4.20	6.10
Mon.	3	4.00	6.10	4.20	6.15
Tue.	4	No L.	No L.	4.20	6.15
Wed.	5	No L. FM	No L.	4.20	6.15
Thu.	6	No L.	No L.	4.20	6.15
Fri.	7	5.00 PM	7.00 PM	4.20	6.15
Sat.	8	5.00	8.10	4.20	6.15
Sun.	9	5.00	9.10	4.20	6.15
Mon.	10	5.00	10.10	4.20	6.20
Tue.	11	5.00	11.10	4.20	6.20
Wed.	12	5.00	12.10 AM	4.20	6.20
Thu.	13	5.00 LQ	1.10	4.20	6.20
Fri.	14	5.00	2.10	4.20	6.20
Sat.	15	5 00	3.00	4.20	6.20
Sun.	16	5.10	4.00	4.20	6 20
Mon.	17	5.10	5.00	4.20	6.20
Tue.	18	5.10	6.20	4.20	6.20
Wed.	19	5.10	6.20	4.20	6.20
Thu.	20	5.10	6.20	4 20	6.20
Fri.	21	5.10 NM	6.20	4.20	6.20
Sat.	22	5.10	6.20	4.20	6.20
Sun.	23	5.10	6.20	4.20	6.20
Mon.	24	5.10	6.20	4.20	6.25
Tue.	25	5.10	6.20	4.20	6.25
Wed.	26	9.00	6.20	4 20	6.25
Thu.	27	10.10	6.20	4.20	6.25
Fri.	28	11.20 FQ	6.20	4.20	6.25
Sat.	29	12.30 AM	6.20	4.20	6.25
Sun.	30	1.40	6.20	4.20	6.25
Mon.	31	2.50	6.20	4.20	6.25







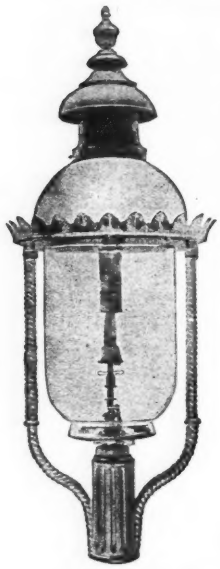
TOTAL HOURS LIGHTING DURING 1900.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	230.50	January	423.20
February	175.40	February	355 25
March	189.00	March	355.35
April	160.30	April	298.50
May	150.40	May	264.50
June	137.00	June	234.25
July	152 00	July	243.45
August	171.50	August	280.25
September	187.20	September	321.15
October	213.10	October	374.30
November	221.50	November	401.40
December	231.50	December	433.45
Total, yr.	2221.40	Total, yr.	3987.45

NEW YORK, 33 Nassau St. PHILADELPHIA, Broad and Arch Sts. CHICAGO, 64 Lake St.

Welsbach Street Lighting Company

.... OF AMERICA ....



No. 36.

Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in seventy-five Cities and Towns.

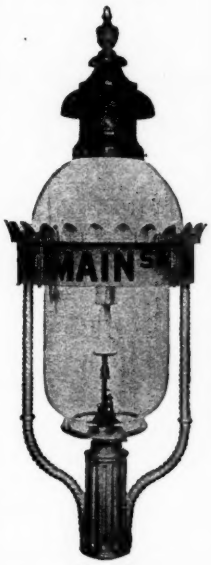
By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.



No. 38.

Correspondence solicited from Gas Companies and others interested in Municipal and outside lighting.

Welsbach Famous Mantles.

THE INCOMPARABLE

"Yusea" Welsbach Mantle

FINEST EXAMPLE

OF INCANDESCENT

GAS LIGHT

EVER EXHIBITED.

OTHER WELSBACH BRANDS —OF— Magnificent Brilliancy —AND— Endurance.

THE HIGHEST ILLUMINATION, The Lowest Cost.

Welsbach Lamps, Mantles, and Complete Line of Glassware and Supplies

WELSBACH COMPANY,

GLOUCESTER, N. J.

Chicago Branch Department and Supply House, - - - - - 70 Wabash Avenue.

THE UNITED GAS IMPROVEMENT COMPANY.

THE STANDARD DOUBLE SUPERHEATER LOWE WATER GAS APPARATUS.

CONTRACTS RECEIVED SINCE JANUARY 1, 1900.

	SETS.		SETS.
DANSVILLE, N. Y.	1	HACKENSACK, N. J.	1
WEST CHESTER, PA.	1	TIFFIN, O.	1
COHOES, N. Y.	2	MOUNT HOLLY, N. J.	1
OGDEN GAS CO., CHICAGO	1	SEATTLE, WASH.	1
CENTRAL UNION GAS CO., NEW YORK	1	TARRYTOWN, N. Y.	1
SPENCER, MASS.	1	HOBOKEN, N. J.	2
SAN FRANCISCO	1	PATERSON, N. J.	2
BROOKLYN UNION GAS CO., BROOKLYN	1	NEWARK, N. J.	2
RICHMOND, VA.	2	JERSEY CITY, N. J.	1
CAMBRIDGE, MASS.	2	AUSTIN, TEX.	1
CARBONDALE, PA.	1	ELIZABETH, N. J.	1

NUMBER OF SETS	28
TOTAL SETS INSTALLED TO JANUARY 1, 1900	327
TOTAL SETS INSTALLED TO DATE	355
TOTAL DAILY CAPACITY	227,000,000 Cubic Feet.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY Prest. DAVID R. DALY V. Prest. & Treas.
H. D. ABERNETHY. Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
Jersey City, N. J.

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CLAY GAS RETORTS, FIRE CLAY TILES,
FIRE BRICK and FIRE CLAY SPECIALTIES

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

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FLEMMING GENERATOR GAS FURNACE

E. D. WHITE, President. A. H. GUTKES, Vice-President. H. A. PERKINS, Secretary.

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MANUFACTURERS OF

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Established 1854. Incorporated 1869.

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Water Gas Cupola Linings, Fire Clay, Etc.

Proprietors for the U. S., Coze System of Inclined Benches.

Estimates Furnished on Application for Most Successful Style of Construction.

Also for Free-Firing and Full and Half-Depth Regenerative Benches, for Burning either Coal or Coke in the Furnaces.

Office: 914, 915 & 916 Wainwright Building, St. Louis, Mo.

The Construction of Gas Works

PRACTICALLY DESCRIBED,

By WALTER RALPH HERRING.

Price $2. For Sale by

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32 Pine Street, N. Y. City.

Adam Weber Sons,

Manhattan Fire Brick and Enameled Clay Retort Works.

Works, Weber, N. J.

Office, 633 East 15th St., New York

Modern Recuperative Furnaces.

Standard Fire Brick and Gas Retorts.

Works, LOCKPORT STATION, PA.

—ESTABLISHED 1864.—

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Successor to WILLIAM GARDNER & SON,

Fire Clay Goods for Gas Works.

SOLE REPRESENTATIVE OF THE McILHENNY REGENERATIVE BENCHES FOR THE U. S.

HENRY MAURER & SON,

(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY

RETORT WORKS

WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y.

Clay Gas Retorts,
BENCH SETTINGS,
Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

Price List, f.o.b. Galesburg, Ills., or Buffalo, N. Y.
In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD, Galesburg, Ills.

For orders East of Buffalo, N. Y., or Pittsburg, Pa., freight will be paid to these points.

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CITY OFFICE,
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OAKHILL GAS RETORT & FIRE BRICK W'KS

Our immense establishment is now employed almost entirely in the manufacture of

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We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnace, and the abrasion of feeding and emptying. We construct

Half and Full Depth Benches of Our Own Design,

Containing 6, 8 or 9 Retorts.

We have Greatly Improved our Recuperators. Coal or Coke can be used as Fuel in Furnaces.

THEO. J. SMITH, Prest. J. A. TAYLOR, Sec.
A. LAMBLA, Vice-Prest. and Supt.

BALTIMORE RETORT & FIRE BRICK CO.

MANUFACTORY AT

LOCUST POINT, BALTIMORE, MD.

Clay Retorts, Blocks & Tiles

FIRE BRICK, FIRE CLAY, AND FIRE CEMENT.

Our Improved Half and Full Depth Benches have been Adopted by Many Gas Companies.

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Sole Agents for New England States.

JOHN DELL, General Manager.

MISSOURI FIRE BRICK CO.,

ESTABLISHED 1882.

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Gas Retorts, Bench Settings, Fire Brick, Cupola Linings, Etc.

We are prepared to furnish and erect COMPLETE, Half and Full Depth Benches of 6's, 8's, 9's, with Regenerative Furnaces, Constructed to Burn either Coal or Coke. Also Plain Benches.

CORRESPONDENCE IS RESPECTFULLY SOLICITED.

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National Gas and Water Company.

CONTRACTORS FOR
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SOFT COAL OR COKE
WATER GAS GENERATORS
A SPECIALTY.

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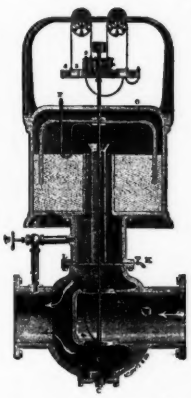
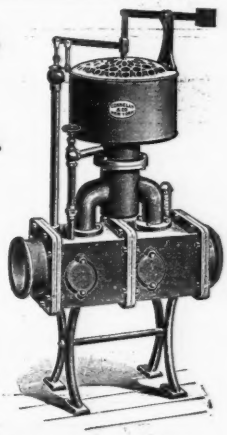
Gas Engineers
INSPECTION AND ADVICE.

PLANS AND ESTIMATES
FOR IMPROVEMENTS OR
REPAIRS.

GAS WORKS SPECIALTIES,



AUTOMATIC STREET GAS GOVERNORS,
BALANCE GAS GOVERNORS.
"Iron Sponge" and Natural Oxide
FOR GAS PURIFICATION.
EXHAUSTERS, ETC.



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NEW YORK CITY.

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Their Construction and Arrangement,

And the Manufacture and Distribution of Coal Gas.

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FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

PARSON'S TAR BURNER.

FOR USING COAL TAR AS FUEL.

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WHARVES, - - - Locust Point Baltimore, Md.
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GAS NAPTHA DEPARTMENT.

GAS NAPTHA.

GAS OIL.

Correspondence Solicited.

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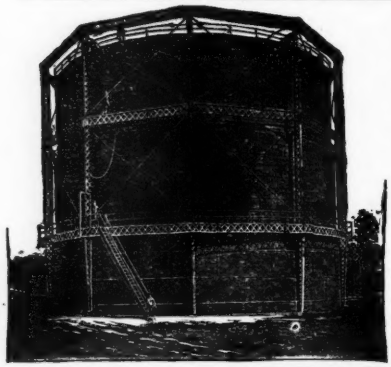

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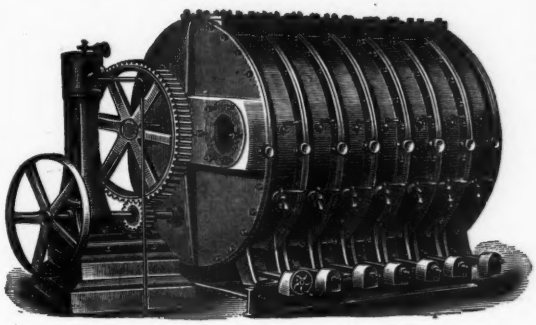

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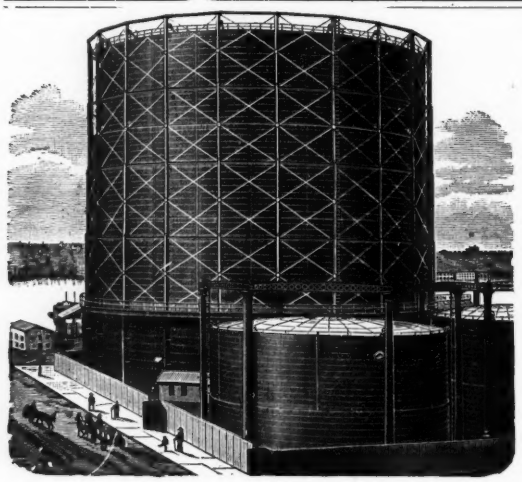

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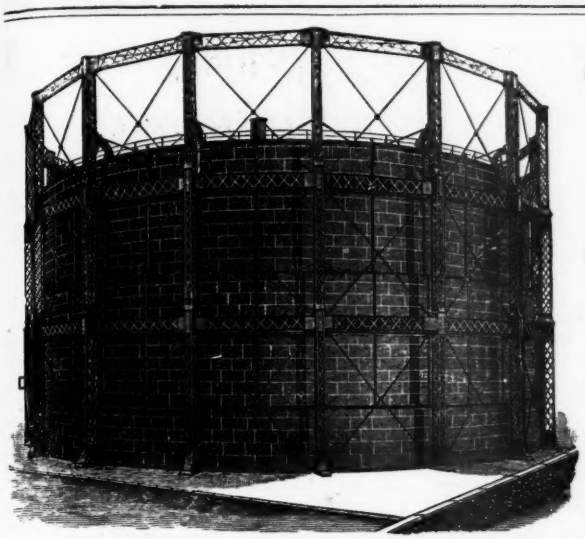

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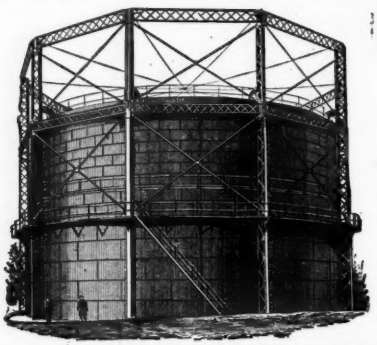

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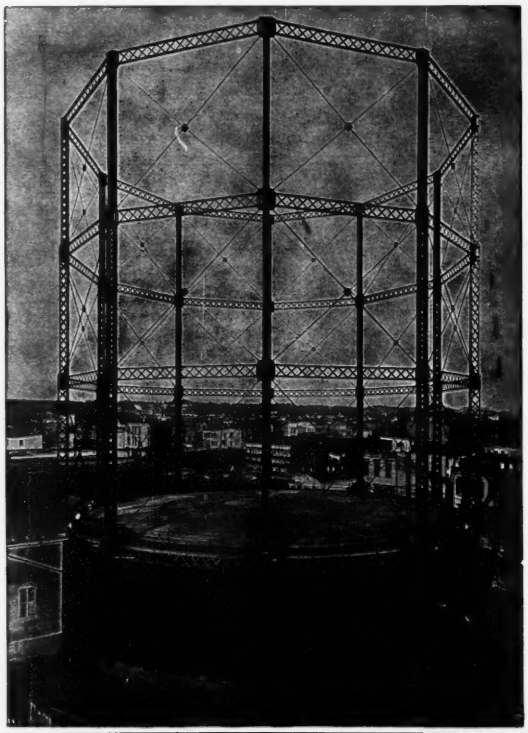

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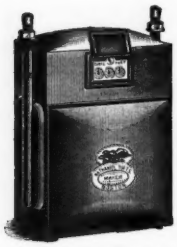

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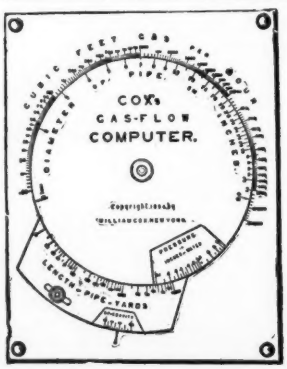

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